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C.A.C. REPORT
No. ZE-28-049

# ERECTION AND MAINTENANCE INSTRUCTIONS FOR MODEL PBY-5A AIRPLANE

RELEASED BY BUREAU OF AERONAUTICS
-NAVY DEPARTMENT-

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CONSOLIDATED AIRCRAFT CORPORATION
SAN DIEGO, CALIFORNIA

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## C. SERVICE REFERENCE DATA

The maintenance of a considerable number of items installed in this airplane is dealt with in publications issued by the manufacturers of aeronautical equipment. These publications are referred to in this manual when they contain applicable instructions.

The titles and sources of the maintenance instructions referred to are listed below:

1. "Engine Operator's Handbook - Twin Wasp, C-3 Engine," Pratt & Whitney Aircraft, East Hartford, Connecticut.

2. "Engine Overhaul Manual - Twin Wasp, C-3 Engine," Pratt & Whitney Aircraft, East Hartford, Connecticut.

3. "Engine Parts List - Twin Wasp, C-3 Engine", Pratt & Whitney Aircraft, East Hartford, Connecticut.

4. "PBY-5A Pilot's Handbook", No. ZE-28-050, Consolidated Aircraft Corporation, San Diego, California.

5. "Service Manual #140-A, Hydromatic Quick-Feathering Propellers", Hamilton-Standard Propeller Company, East Hartford, Connecticut.

6. "Handbook of Instructions for Pesco High Pressure Pump #R-280-BH", "Pesco Pump #437", and "Pesco Pump #265-DA", Pump Engineering Service Company, Cleveland, Ohio.

7. "Service Manual - Stromberg Injection Carburetors for Aircraft", Bendix Products Division, Bendix Aviation Corporation, South Bend, Indiana.

8. "Instruction Book for Type RL-24B Aircraft Interphone Equipment", Telephonics Corporation, New York, New York.

9. "Goodrich De-Icer Bulletin #107", Goodrich Rubber Company, Akron, Ohio.

10. "Catalogue E - Type B-3 Vacuum Pump", Overhaul Manuals, Eclipse Aviation Corporation, Bendix, New Jersey.

11. "Instruction Manual, Hand and Electric Inertia Starters, Types JH 5 and JH 10", Jack and Heintz Incorporated, Cleveland, Ohio.

12. "Instructions for Aircraft Heater, Type 789", Stewart Warner Company, 1826 Diversey Parkway, Chicago, Illinois.

# SECTION II

## SHIPMENT OF AIRCRAFT

### A. Shipment by Railroad

Shipment of the airplane by railway will require three cars: one 50-foot closed-end loading car and two special 50-foot by 10-foot flat cars not more than 44 inches high from the rails to the floor of the car.

The wings shall be racked in the closed car as follows:

1. Remove trailing edge assemblies from all panels and wing-tip floats from outer panels.

2. Rack the center section, with leading edges and oil tanks installed against side of car.

3. Rack the two outer panels, so that a root and a tip are together at each end.

4. Secure outer panel trailing edges, floats, elevators, rudder and as many miscellaneous items as possible in remainder of car.

The hull must be cradled on one of the flat cars so that the aft end overhangs the other flat car. It is necessary to provide the special cradles shown on Figure 4 and to locate them as shown on Figure 3, so that the overall height will meet the necessary railroad clearance requirements. Lash the cradles and hull securely to the car and cover them with canvas. The engine mounts can be secured to the car under the bow. The landing gear shall be installed on the airplane and retracted into the hull.

The remainder of the airplane is to be boxed or secured and covered on the second flat car.

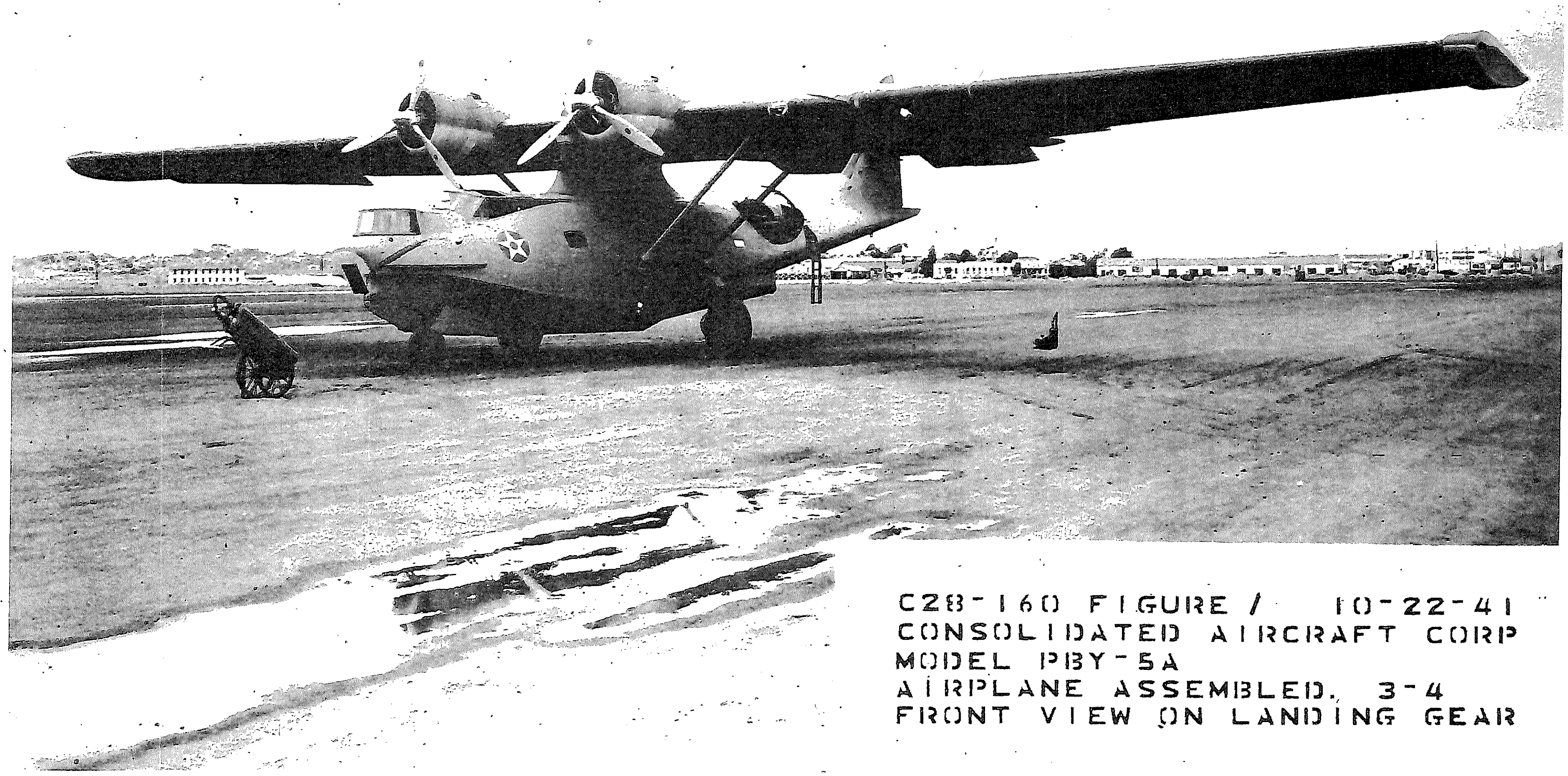
### B. Overseas Shipment

Overseas shipment will require three crates. The size of the crates together with the airplane parts placed in the crates are listed below.

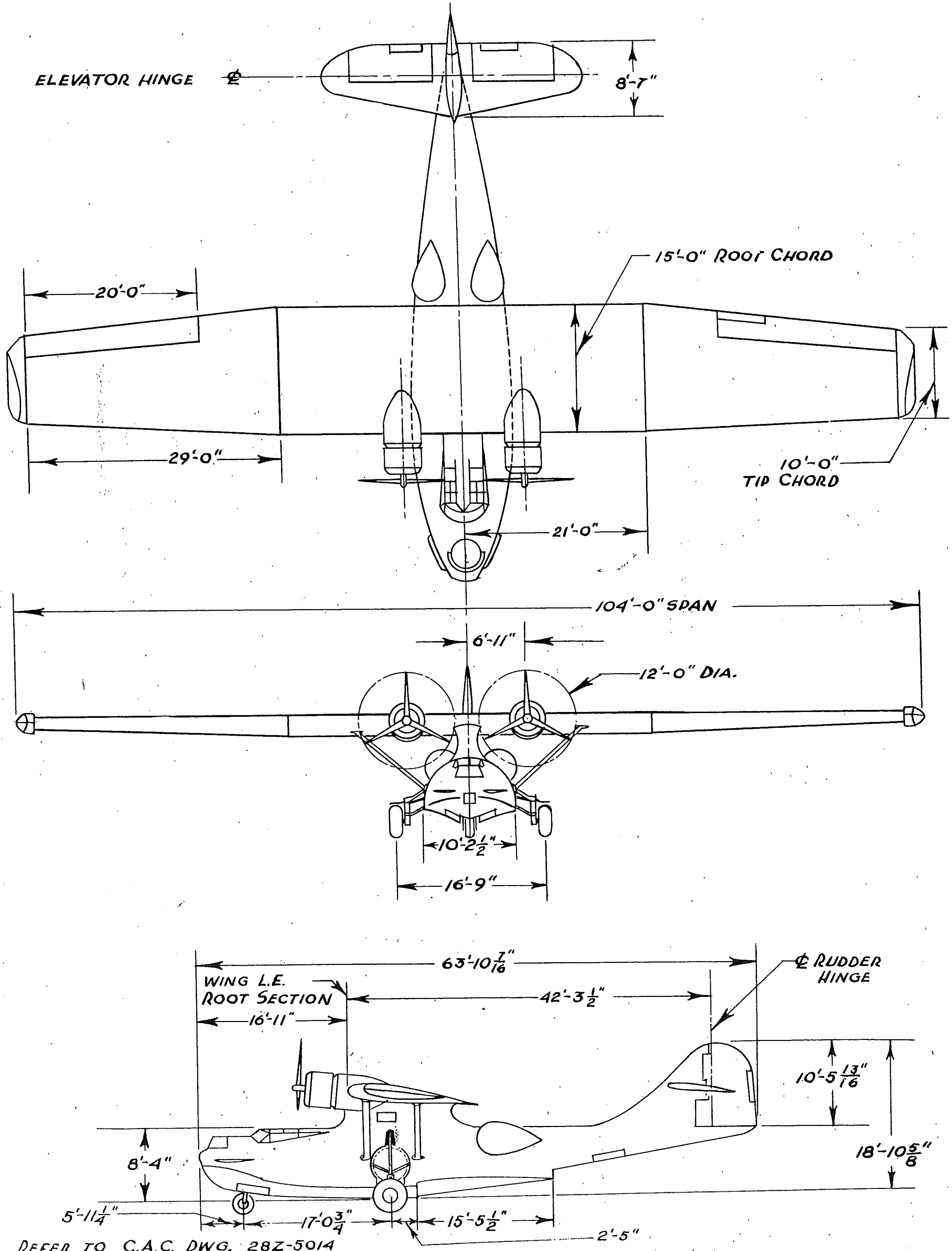
1. The "A" Crate, 65 ft. long, 10-1/2 ft. wide and 13 ft. high, shall contain the following:

   a. The hull, cradled as shown in Figures 3 and 4.
   b. Engine mounts less engines, racked outside hull.
   c. The rudder, racked under aft end of hull.

Note: The landing gear shall be installed on and retracted into the hull.



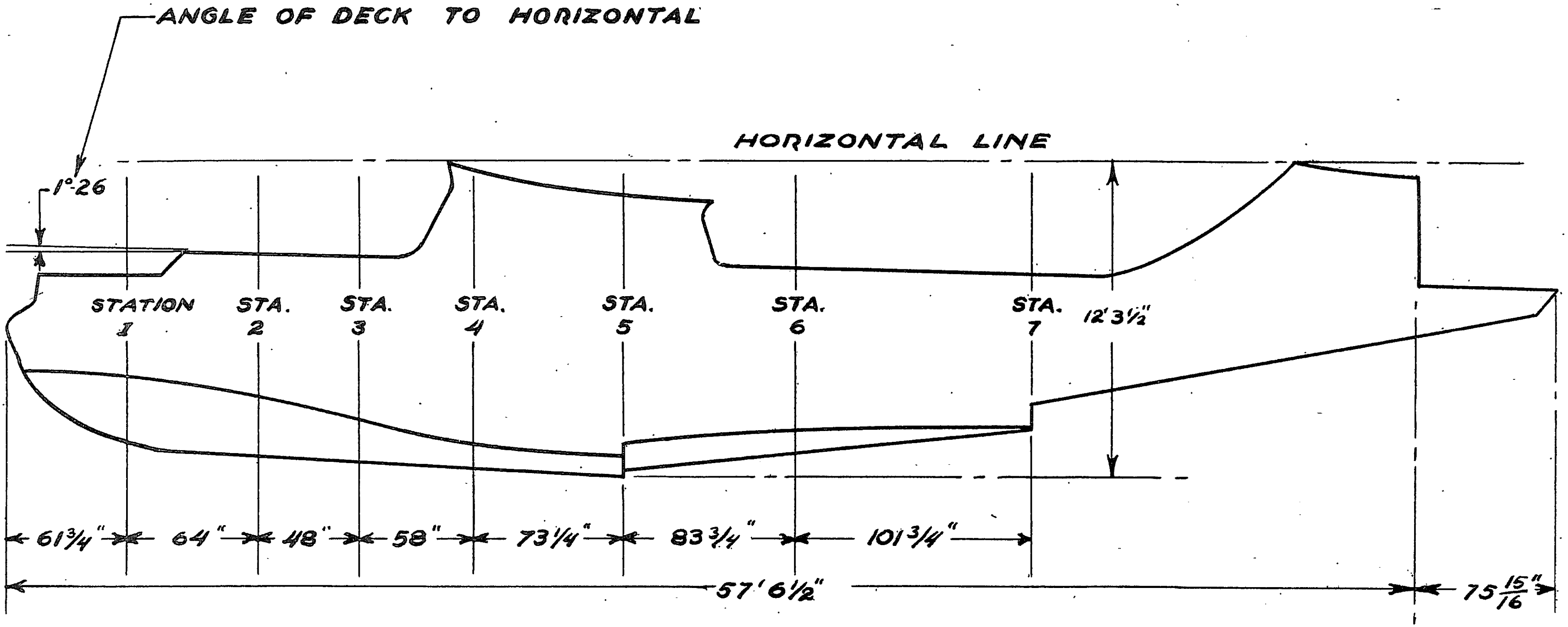
C28-160 FIGURE / 10-22-41
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A
AIRPLANE ASSEMBLED. 3-4
FRONT VIEW ON LANDING GEAR



REFER TO C.A.C. DWG. 28Z-5014

**FIGURE 1**

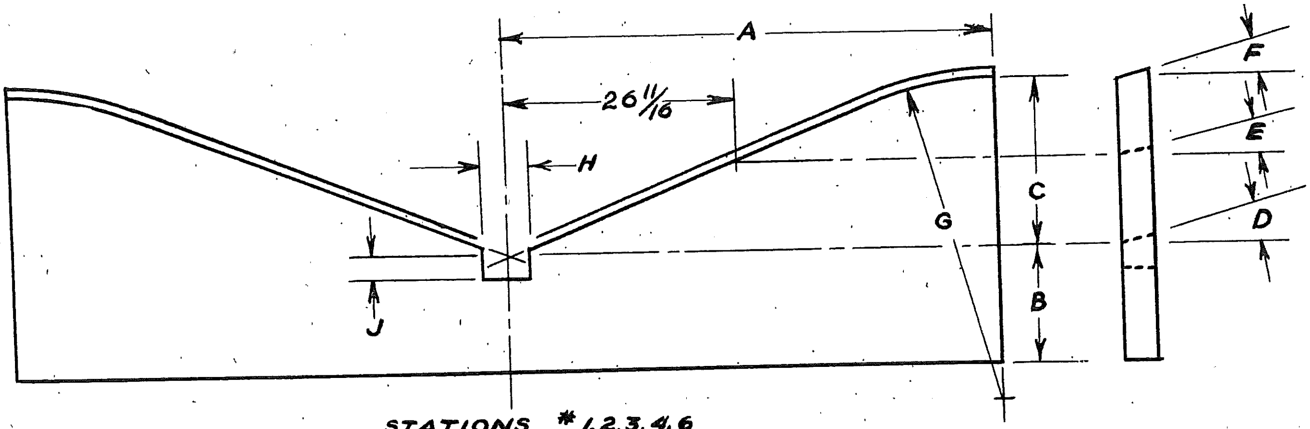
**THREE-VIEW DRAWING OF PBY-5A AIRPLANE**



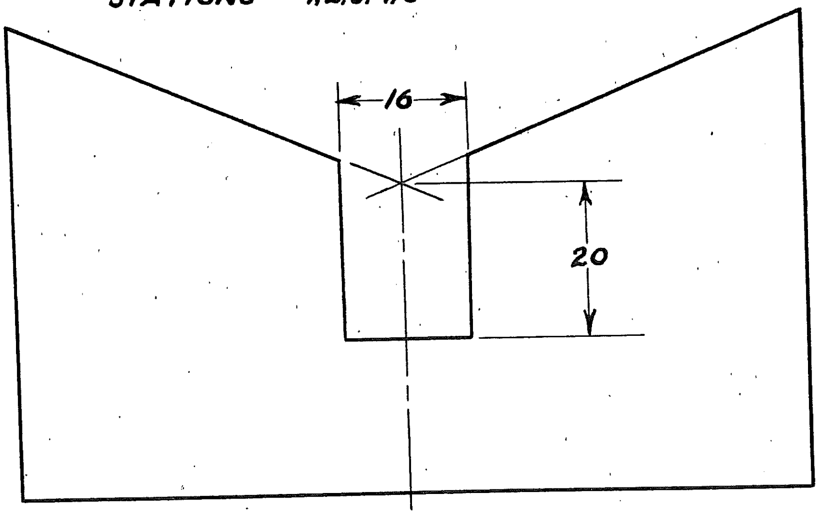
NOTE: OVERALL WIDTH OF HULL (MAXIMUM) AT BULKHEAD #4 OVER BEACHING GEAR LOWER STEEL FITTING IS 10'7".

CRADLE BULKHEAD IS NOT REQUIRED AT STATION #3 BUT MAY BE USED TO FACILITATE CRATING OVER DECK OF HULL

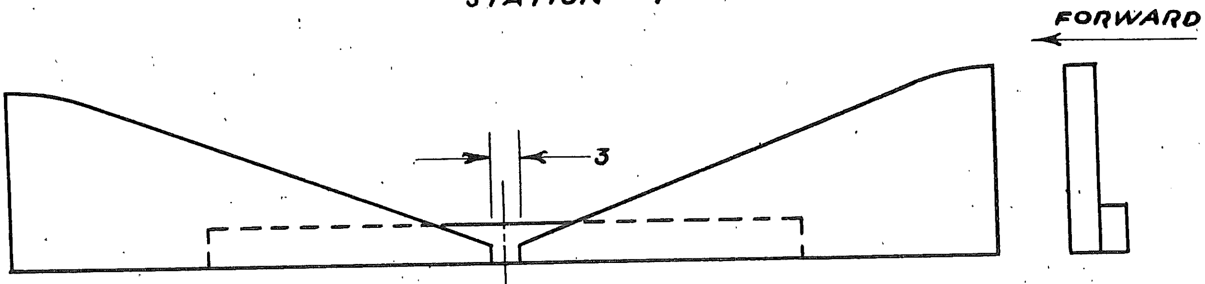
FIGURE 3
SHIPPING CRADLE POSITIONS



STATIONS #1,2,3,4,6



STATION #7



STATION #5

TABLE OF BULKHEAD DIMENSIONS

| | STATION | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| A | 47 1/4 | 59 29/32 | 61 1/4 | 61 1/4 | 61 1/4 | 58 15/16 | 49 1/2 |
| B | 17 3/8 | 10 | 7 1/2 | 5 | 2 | 13 3/8 | 38 3/4 |
| C | 32 11/32 | 26 3/32 | 22 3/8 | 21 3/32 | 21 3/32 | 17 15/16 | 20 1/2 |
| D | 12° | 4 1/2° | 2 1/2° | 2 1/2° | 2 1/2° | 4 1/2° | 9 1/2° |
| E | 21° | 8° | 4° | 2 1/2° | 2 1/2° | 4 1/2° | 9 1/2° |
| F | 13 1/2° | 9 1/2° | 5 1/2° | 2 1/2° | 2 1/2° | 4 1/2° | 9 1/2° |
| G | 22 5/32 | 41 | 49 7/16 | 51 13/16 | 51 13/16 | 44 1/32 | NO RADIUS |
| H | 6 | 3 | 3 | 3 | 3 | — | — |
| J | 3 | 1 1/2 | 1 1/2 | 1 1/2 | — | — | — |

REFER TO C.A.C. DWG. 28B003

FIGURE 4
SHIPPING CRADLE BULKHEADS

2. The "B" Crate, 42-1/2 ft. long, 9 ft. wide and 15-1/2 ft. high, shall contain the following:

a. Two outer panels complete with leading and trailing edges. Rack panels and leading edges with wing taper at opposite ends.

b. Center section complete with leading and trailing edges. Engines and mounts shall not be installed. Rack section between outer panels, and support section at motor mount fittings.

c. Wing tip floats, attached to outer panels in retracted position.

3. The "C" Crate, 30-1/2 ft. long, 9-1/2 ft. wide and 6 ft. high, shall contain the stabilizer and upper fins. Rack the elevators on either side of the stabilizer.

The engines shall be shipped in their original crates.

## SECTION III

## ERECTION PROCEDURE

### A. Wing

#### 1. Handling of Wing

a. Description (Ref. C.A.C. Dwg. 28W4001)

The wing consists of several assembled units which may be readily assembled or disassembled independently of each other. These are the outer panels, a center section, leading edges, trailing edges, floats and ailerons.

The wing may be assembled on the airplane or on the floor and then installed as a complete unit. In either case, the handling of the center section will be the same.

b. Hoisting (Ref. Figures 5 and 6 )

The center section may be hoisted individually by hoist fittings on the airplane centerline at the front and rear spars. Connecting pins are attached to the sling by short lines as shown on Figure 5 . When not in use, the sling is stowed in the engineer's compartment on the front face of bulkhead #5.

If the entire wing is to be hoisted, attach trimming lines to the handling fittings in the leading edge, as shown on Figure 13 . The wing may be hoisted either with or without the engines installed.

For hoisting the wing outer panel, two fittings at the front and rear spar near the wing splice and another inside the access door to the float lock and recoil mechanism are provided as shown by numbers 2 and 7 on Figure 13 . Hoist dimensions are given on Figure 6 .

#### 2. Attachment of the Wing Center Section to the Hull

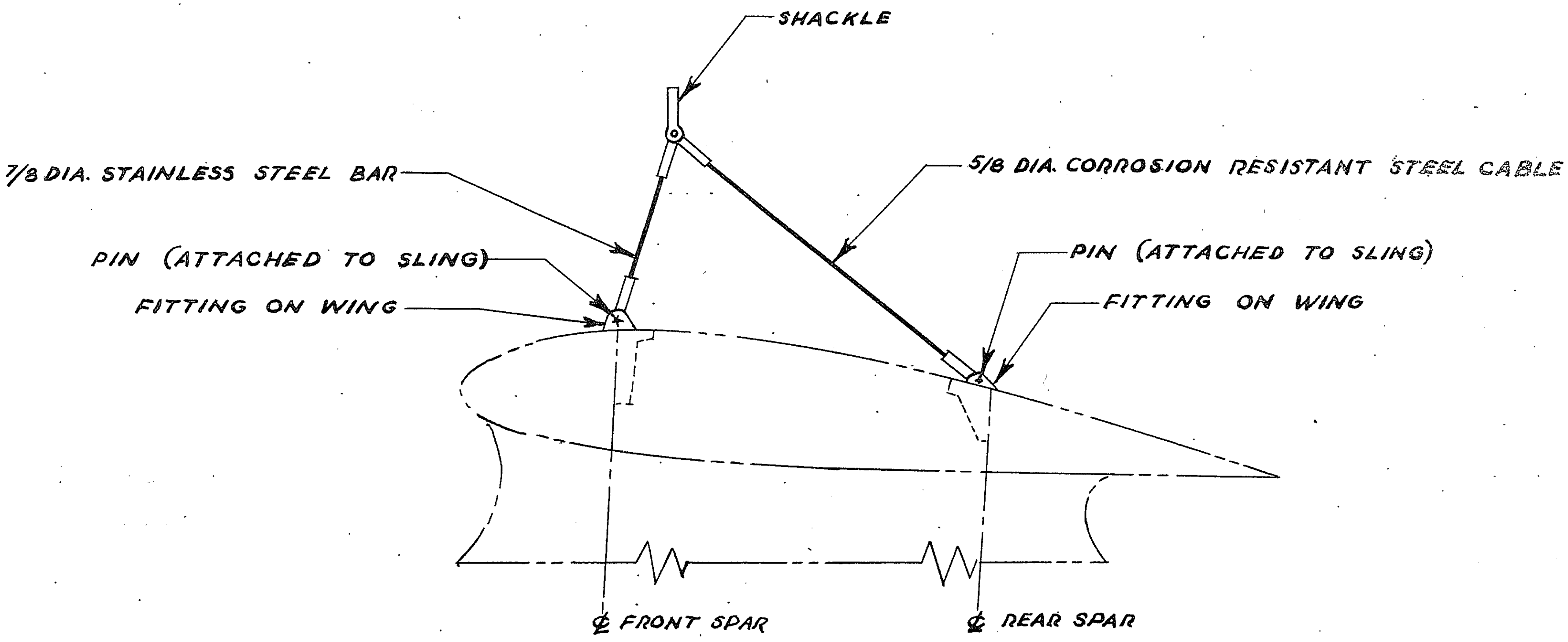
To attach the center section to the hull:

a. Hoist wing to clear hull, as described above in paragraph "b".

b. Place hull under wing.

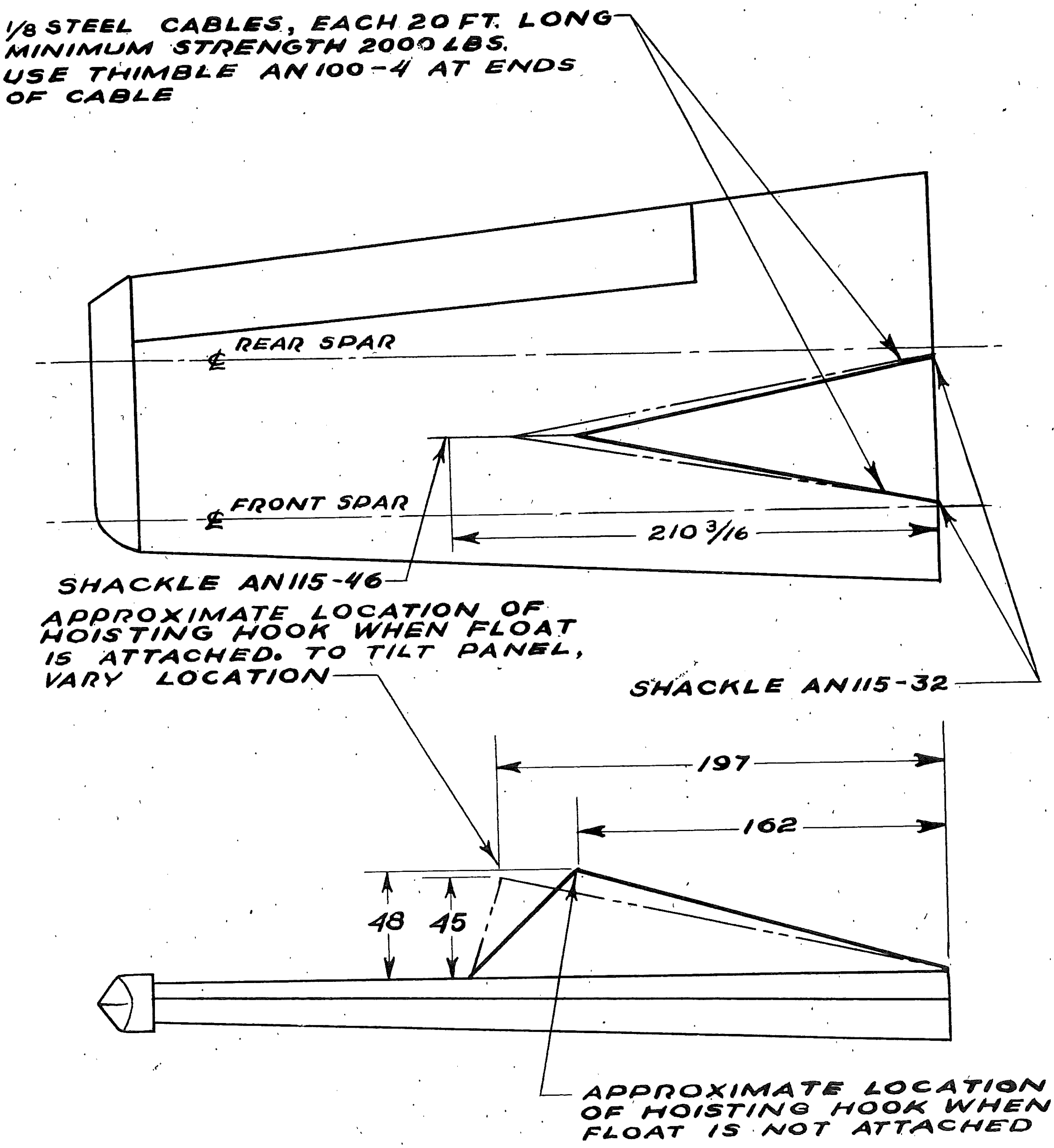
c. Level hull approximately. The fore and aft leveling block is located between bulkheads #4 and #5 on the port side. Transverse blocks are on the aft port face of bulkhead #5.

M.R.H.
PBY-5A



REFER TO C.A.C. DWG. 28H1003

FIGURE 5
HOISTING SLING


1/8 STEEL CABLES, EACH 20 FT. LONG
MINIMUM STRENGTH 2000 LBS.
USE THIMBLE AN 100-4 AT ENDS OF CABLE
℄ REAR SPAR
℄ FRONT SPAR
210 3/16
SHACKLE AN115-46
APPROXIMATE LOCATION OF HOISTING HOOK WHEN FLOAT IS ATTACHED. TO TILT PANEL, VARY LOCATION
SHACKLE AN115-32
197
162
48
45
APPROXIMATE LOCATION OF HOISTING HOOK WHEN FLOAT IS NOT ATTACHED

REFER TO C.A.C. DWG. 28W180

FIGURE 6
OUTER PANEL HOIST

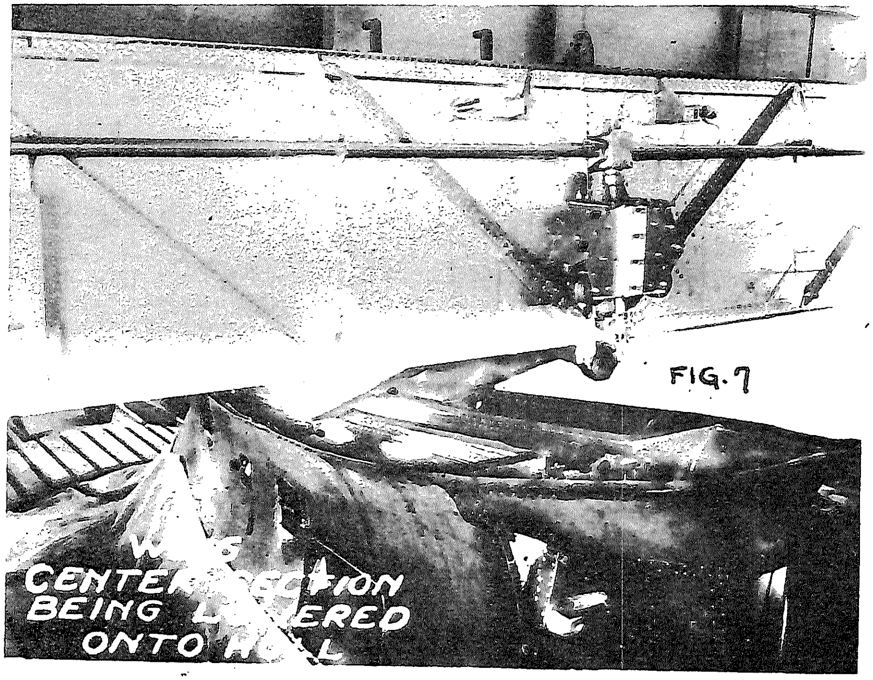


FIG. 7

WING CENTER SECTION BEING LOWERED ONTO HULL

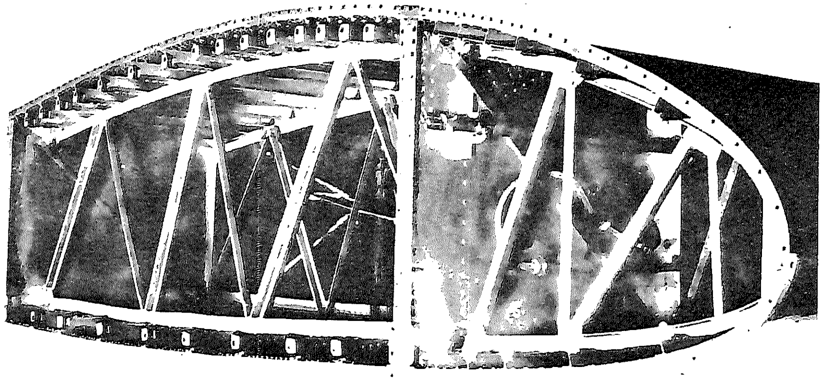


FIG. 8

OUTER PANEL ABOUT TO BE ATTACHED TO CENTER SECTION

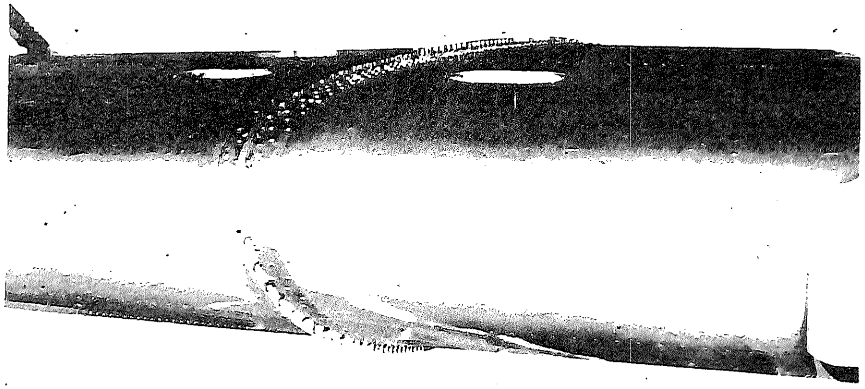


FIG. 9

OUTER PANEL ATTACHED TO CENTER SECTION

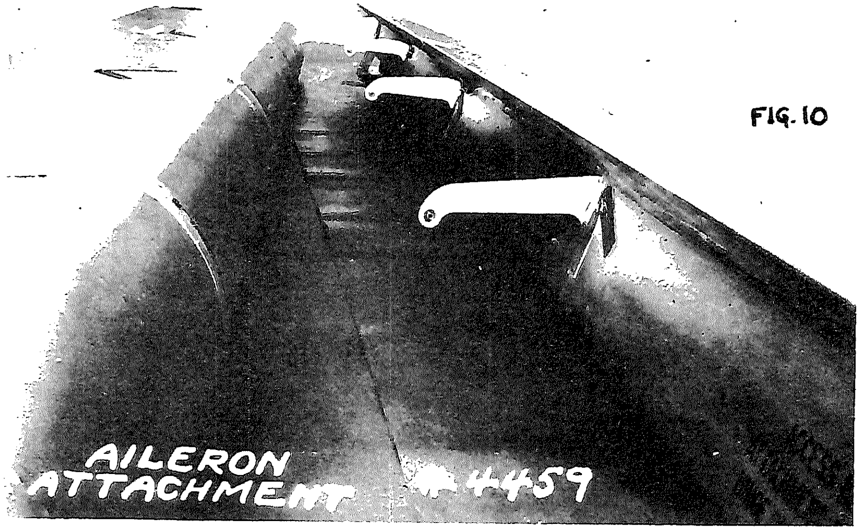


FIG. 10

AILERON ATTACHMENT

d. Lower wing slowly.

  (1) If leading edge is attached, pull flexible conduits through openings provided in lower surface of wing leading edge.

  (2) Caution: Fuel tank sumps must not be permitted to rest on any part of hull superstructure.

  (3) If power plants are attached, engine and nacelle controls must be kept clear.

e. Attach front and rear fittings. Insert bolts in a fore-to-aft direction.

f. Attach struts.

Bolt lower ends first. Insert bolts in a fore-to-aft direction. Lower ends of struts are marked with numbers corresponding to numbers on hull.

g. Attach strut boot fairings.

h. Connect wiring to correspondingly numbered terminals in junction boxes.

i. Connect:
  (1) Engine controls per marked bands.
  (2) Float control shafts.
  (3) Bomb and Torpedo controls per marked terminals.
  (4) Dump Valve Controls
  (5) Fuel and Oil Lines.
  (6) Instrument Lines.
  (7) Aileron Controls

j. After attaching center section leading edge, bolt dump valve pulley bracket brace to leading edge rib, through top center access door. Disconnect brace before removing leading edge from center section.

3. Assembly of Outer Panels

To attach the outer panels to the center section proceed as follows:

a. Turn float retracting mechanism in outer panel so that retracting trunion is against its outboard stop as described in Section IV - Part H. When trunion is in this position, the retracting link will be fully extended from lower surface of wing.

b. Turn center section float controls so as to mesh with this position of outer panel controls.

c. Hoist panel to necessary height.

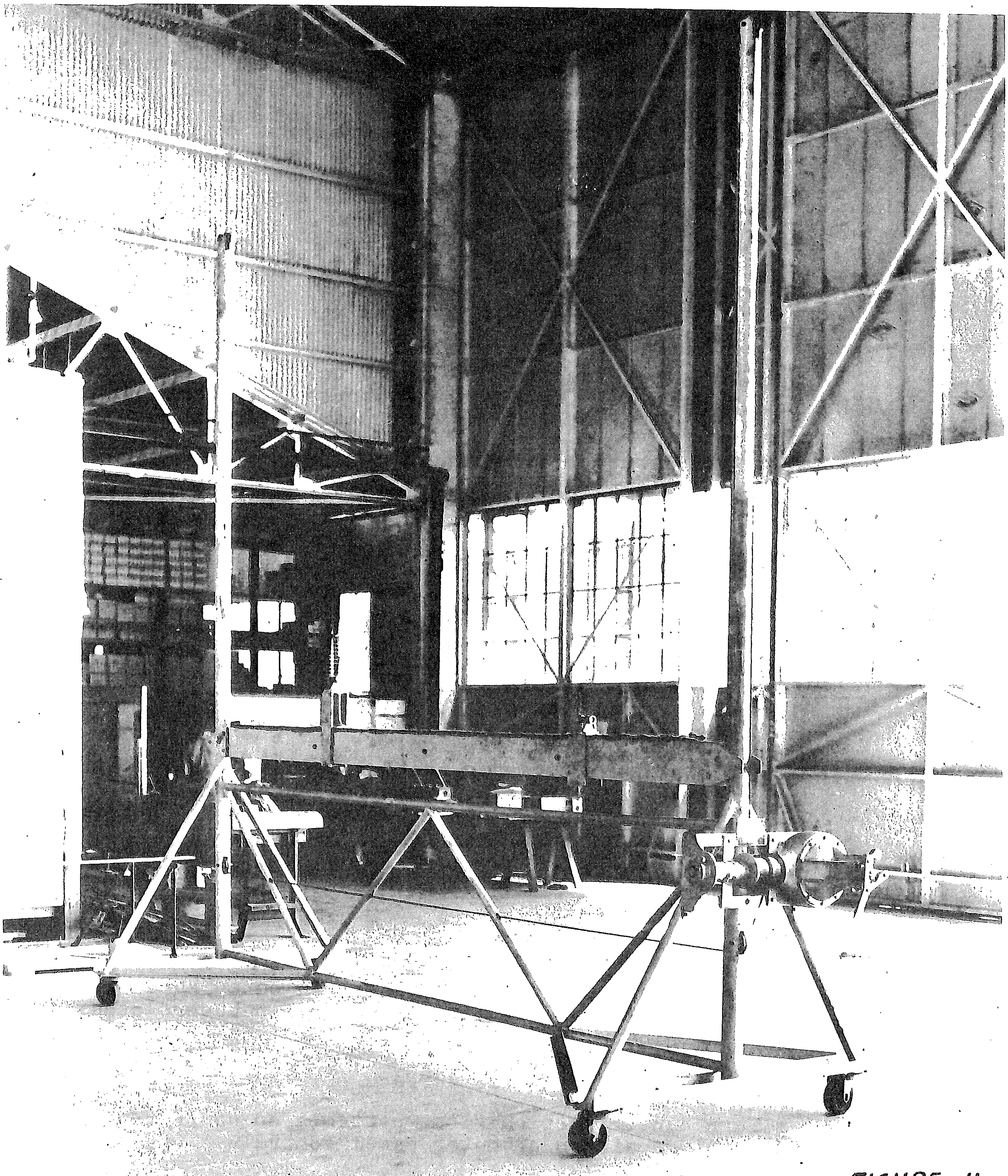


FIGURE 11

NO. 10029 CONSOLIDATED AIRCRAFT CORP.
ELEVATOR FOR RAISING
OUTER WING PANELS

d. Move panel toward center section in such a manner that aileron control tube projecting from center section enters rear section of panel aft of rear spar.

e. Caution: Do not allow aileron tube to strike trailing edge structure of outer panel.

f. The outer panel should now be in position for attachment.

g. Insert bolts in center section and outer panel flange holes and secure. Recommended force with a 12" wrench for an AN-4 steel bolt is 4 to 7 pounds; for an AN-5 steel bolt, 7 to 12 pounds; for an AN-7 steel bolt; 29 to 50 pounds.

h. Attach stringers from inside of wing. A manhole for access to these fittings is located in the upper wing surface of the outer panel as shown by #6 on Figure 13.

i. Join the inner spar connections. The outer connections may be reached through hand holes provided in the leading edge as shown by # 20 on Figure 13 .

j. Attach leading edges through hand holes mentioned above. No trailing edge structural attachment is made at this point.

k. Perform the following operations:

(1) Pull flexible conduit from outer panel into center section at opening provided.

(2) Pull wires through fitting into junction box at end of center section.

(3) Screw coupling nut to fitting in box.

(4) Connect wires to terminal studs marked with corresponding numbers. This box is accessible through hand holes on surface of leading edge as shown by # 17 on Figure 13.

l. Attach fairing over splice.

4. Attachment of Leading Edge

The leading edge may be attached to the interspar structure t any stage of assembly, but preferably before the wing is attached o the hull.

a. Attach leading edge by means of tapping screws through outstanding angle legs at top and bottom of front spar.

b. Apply liberal coating of "paralketone" to upper and lower mounting surfaces of leading edge. Assemble leading edge while "Paralketone" is wet.

c. The screws are automatically locked by self-locking stop nuts on front spar.

### 5. Attachment of Trailing Edge

The trailing edges may be attached to the interspar structure at any point during assembly, but preferably before the wing is attached to the hull. The method of attachment is identical with the leading edge attachment outlined above. Attach the trailing edge section containing the aileron cutout in like manner. Bolt the aileron hinges to the rear spar. Hand holes are provided for access to these bolts as shown by #5 on Figure 13

### 6. Attachment of Trailing Edge Sections to Each Other

The center section trailing edge is in two parts that are to be bolted together. Bolt outer panel trailing edge to trailing edge containing aileron cutouts. Zipper panels are provided for this purpose. After bolting, dope fabric strips over the connection. There is no connection between the center section trailing edge and the outer panel trailing edge.

### 7. Installation of Aileron (Ref. Section IV, Part L-3-a).

To install aileron:

a. Insert bolts at hinges. Bolts are accessible through zipper openings in aileron at each hinge. Align end hinges and locate others to suit.

b. Attach control push-pull rod to aileron bellcrank. Bellcrank is accessible through door in top of wing as shown by #29 on Figure 13.

c. A fixed tab on the trailing edge of the starboard aileron is used to trim the airplane laterally for average flight. It may be adjusted on the field by bending. It should not be necessary to bend it more than 10 degrees.

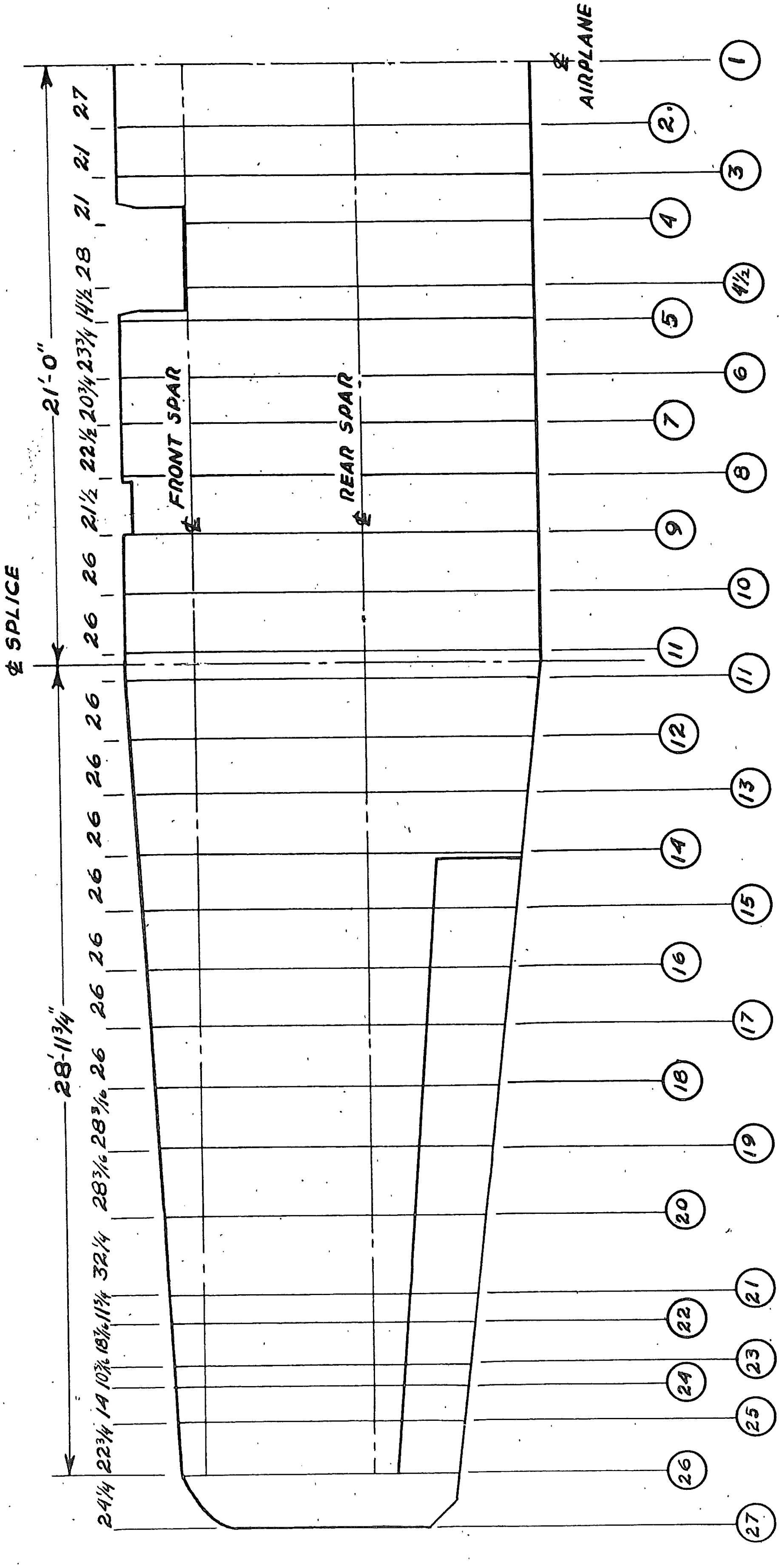
For aileron controls diagram, see Figure 69.

### 8. Wing Handling Line Fitting

This fitting is located in the leading edge of the outer panel, as shown by #19 on Figure 13. The U-shaped ring is flush with the leading edge and may be extended by pushing on the lower end.

### 9. Provisions for preventing Corrosion in the Wing

The Contractor has made provisions for preventing corrosion to the wing internal structure and equipment. The precautions listed should be taken to insure miximum protection: Drain holes are provided in the lower surfaces of the leading and trailing edges. Keep the holes free of dirt and extraneous matter at all times.



REFER TO C.A.C. DWG. 28R2102

FIGURE 12
WING STATIONS DIAGRAM

Rubber plugs are provided for:

Bomb and torpedo hoist slots in upper surface of wing.

Bomb release bellcrank slots in lower surface of wing.

Torpedo hoist cable slots in lower surface of wing.

Work platform slots in wing leading edges.

Care should be taken to replace these plugs whenever the equipment is not installed.

Aluminum alloy screws are used to fill the holes in the lower surface of the wing, necessary to the installation of bomb and torpedo racks. Replace these screws when the eqipment is removed. Make certain that steel bolts are used to install the racks.

Fabric discs are provided to cover drift holes in both upper and lower flanges of the rear spars as shown on Figure Remove discs when replacing trailing edge. After installing a trailing edge, cover holes by applying a 1/2" diameter disc of pre-doped balloon cloth to the surface with clear lacquer. Finish to match adjacent surfaces as shown on C.A.C. Drawing 28W4001.

## 10. Accessibility to Inside of Wing (Ref. Figure 13 )

A 10-inch by 20-inch manhole is provided on the wing upper surface on each side of the centerline, to provide access for inspection and repair of the inside of the fuel tanks. These are shown as # 12 and 31 on Figure 13.

Another 10-inch by 20-inch manhole is located on the wing upper surface outboard of each wing splice. This manhole gives access to the inside of the interspar structure for inspection and repair as far inboard as the fuel tank (Station #5.0) and as far outboard as the float hinge point. All access doors and openings are shown on Figure 13. The key to Figure 13 follows immediately after the figure.

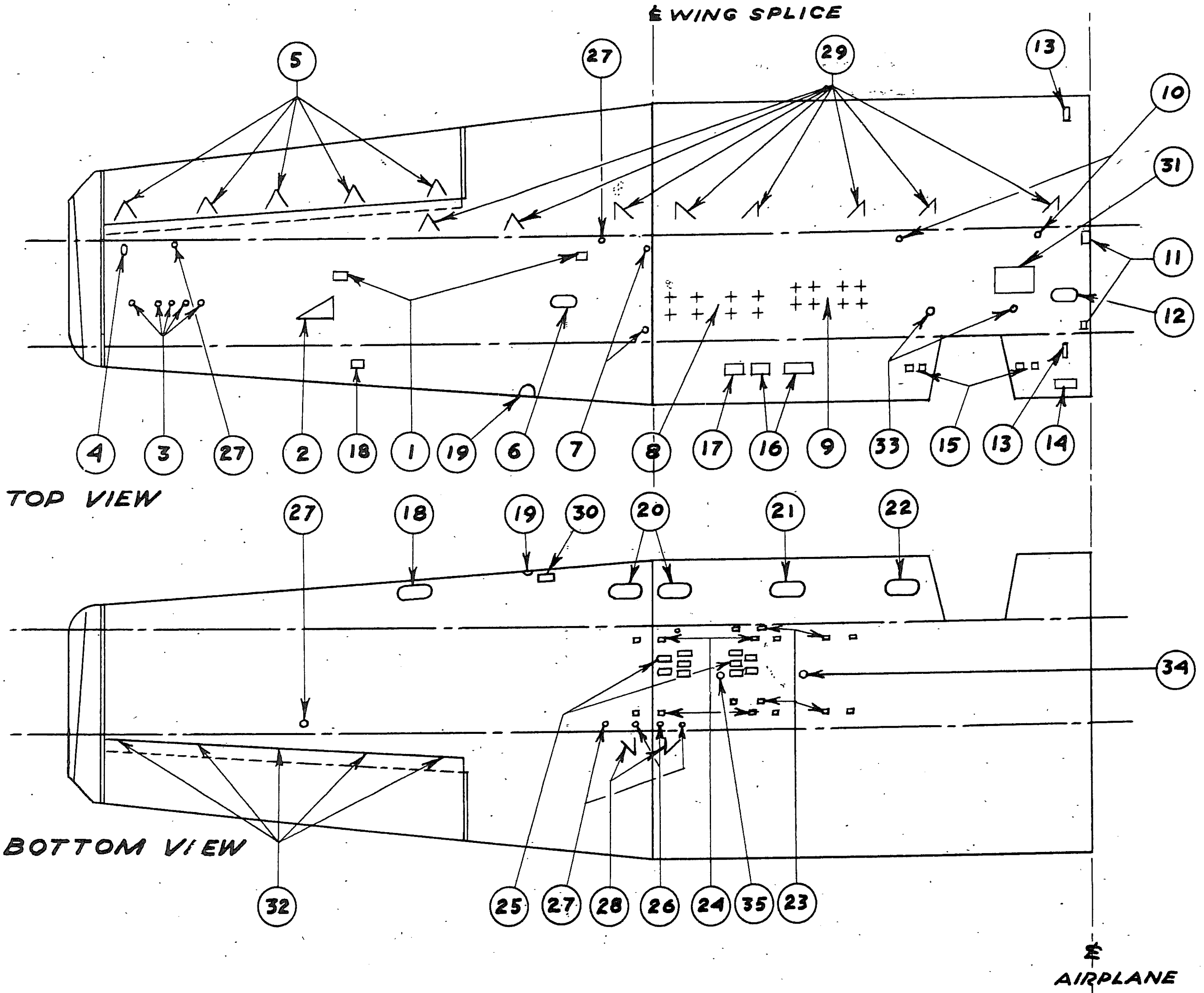
## 11. Wing Walkways (Ref. C.A.C. Drawing 28W2192)

Walkways are provided on the wing as follows:

Along the front spar across the entire span.

At the airplane centerline from the rear spar to the trailing edge.

Between the front and rear spar to the wing splice.



REFER TO C.A.C. DWG. 28W2192

FIGURE 13
WING ACCESS DOORS AND OPENINGS

1. Access Door to Aileron Control
2. Access Door to Float Lock & Panel Hoist Fitting
3. Oil Holes for Float Retracting Mechanism
4. Antenna Mast
5. Access to Aileron Hinge
6. Access Door to Wing Splice
7. Panel Hoist Fittings
8. Bomb Hoist Attachment Fittings
9. Torpedo Hoist Attachment Fittings
10. Engine Hoist Anchorage
11. Hoist Fittings
12. Manhole to Fuel Tank
13. Hand Grip
14. Access Door to Ignition Junction Box
15. Work Platform Support
16. Access to Bomb & Torpedo Control Disconnectors
17. Junction Box
18. Access Door to Float Control Gear Box
19. Wing Line Fitting
20. Access Door to Float Torque Tube Coupling & Wing Splice
21. Landing Light Access Door
22. Access to De-Icing Connection
23. Torpedo Loading Platform Attachment Fittings
24. Bomb Loading Platform Attachment Fittings
25. Access Doors to Bomb Loading Attachments
26. Drain Holes
27. Driftholes for Trailing Edge Installation
28. Zipper Access Openings to Wing Splice
29. Zipper Access Openings to Aileron Control. Two Openings only on Trailing Edge of Right Wing Outer Panel.
30. Access Door to Wing Line Fitting
31. Access Door to Fuel Cells
32. Zipper Openings on Aft Face of Aileron Cut-out. Access to Aileron Hinge.
33. Propeller Hoist Brace Wire Fittings
34. Access to Torpedo Rack Connections
35. Cover Plate for Access to Bomb Rack Electrical Connections

KEY TO FIGURE 13

WING ACCESS DOORS AND OPENINGS

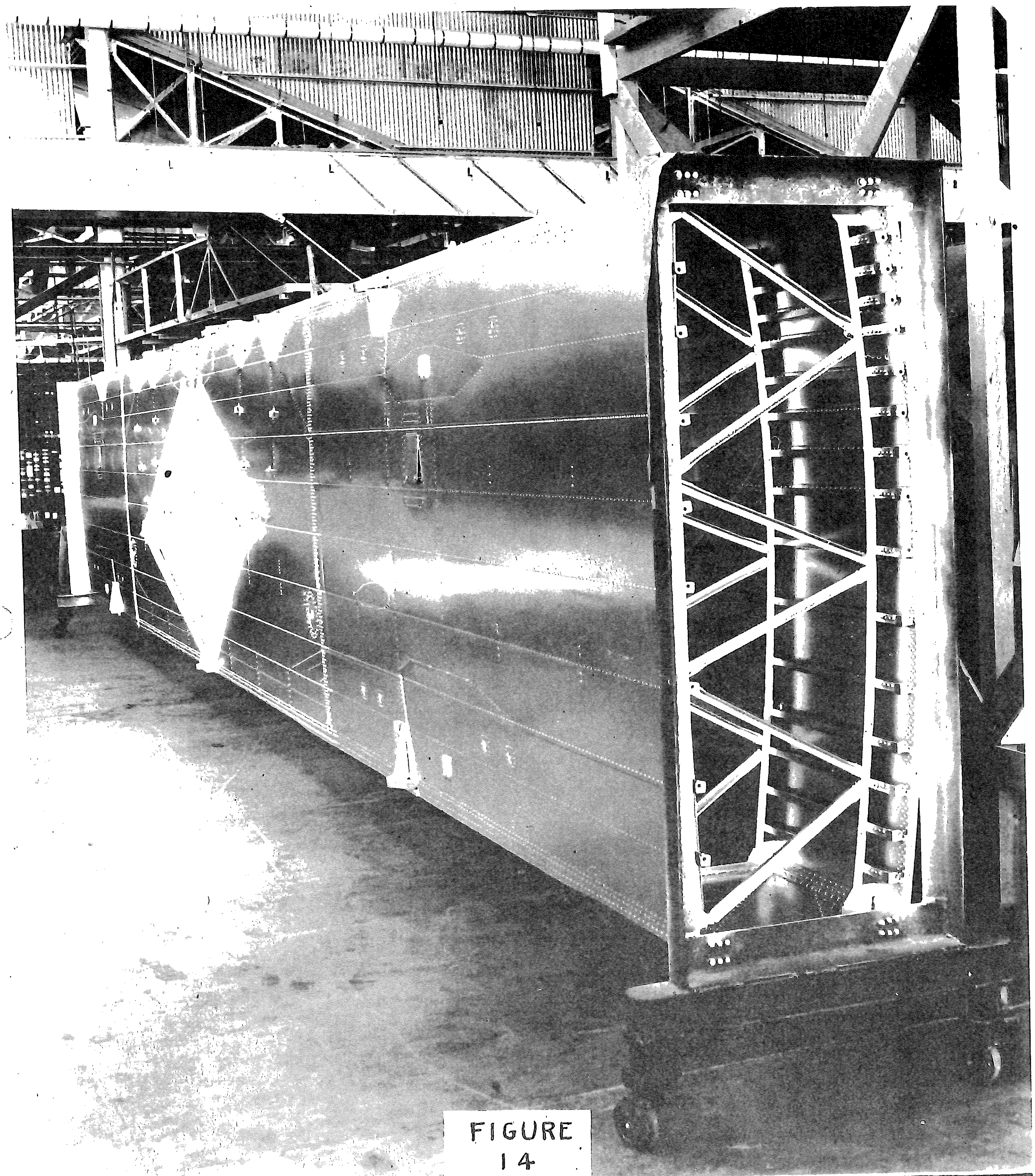
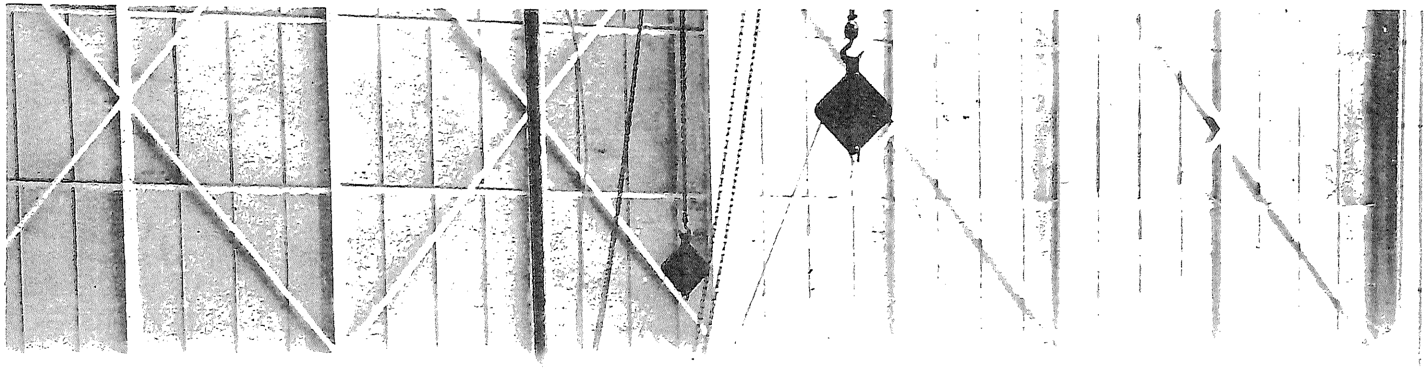


FIGURE 14

NO. 10030 CONSOLIDATED AIRCRAFT CORP. 9-22-36
DOLLIES USED FOR HANDLING
WING CENTER SECTIONS



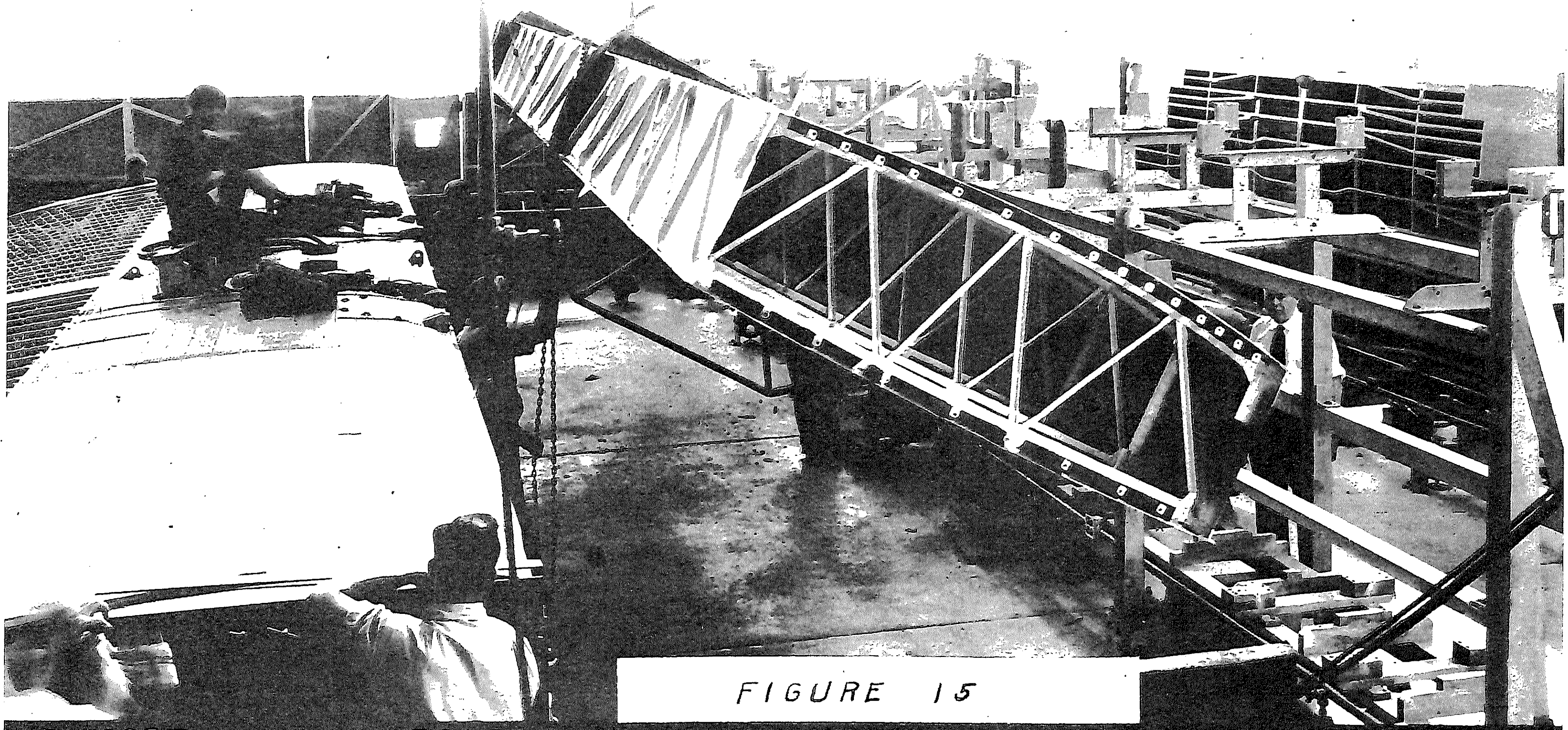


FIGURE 15

NO. 10027 CONSOLIDATED AIRCRAFT CORP. 9-3-36
VIEW SHOWING RINGS USED TO TURN PBY
WING CENTER SECTION FROM VERTICAL TO HORIZONTAL POSITION

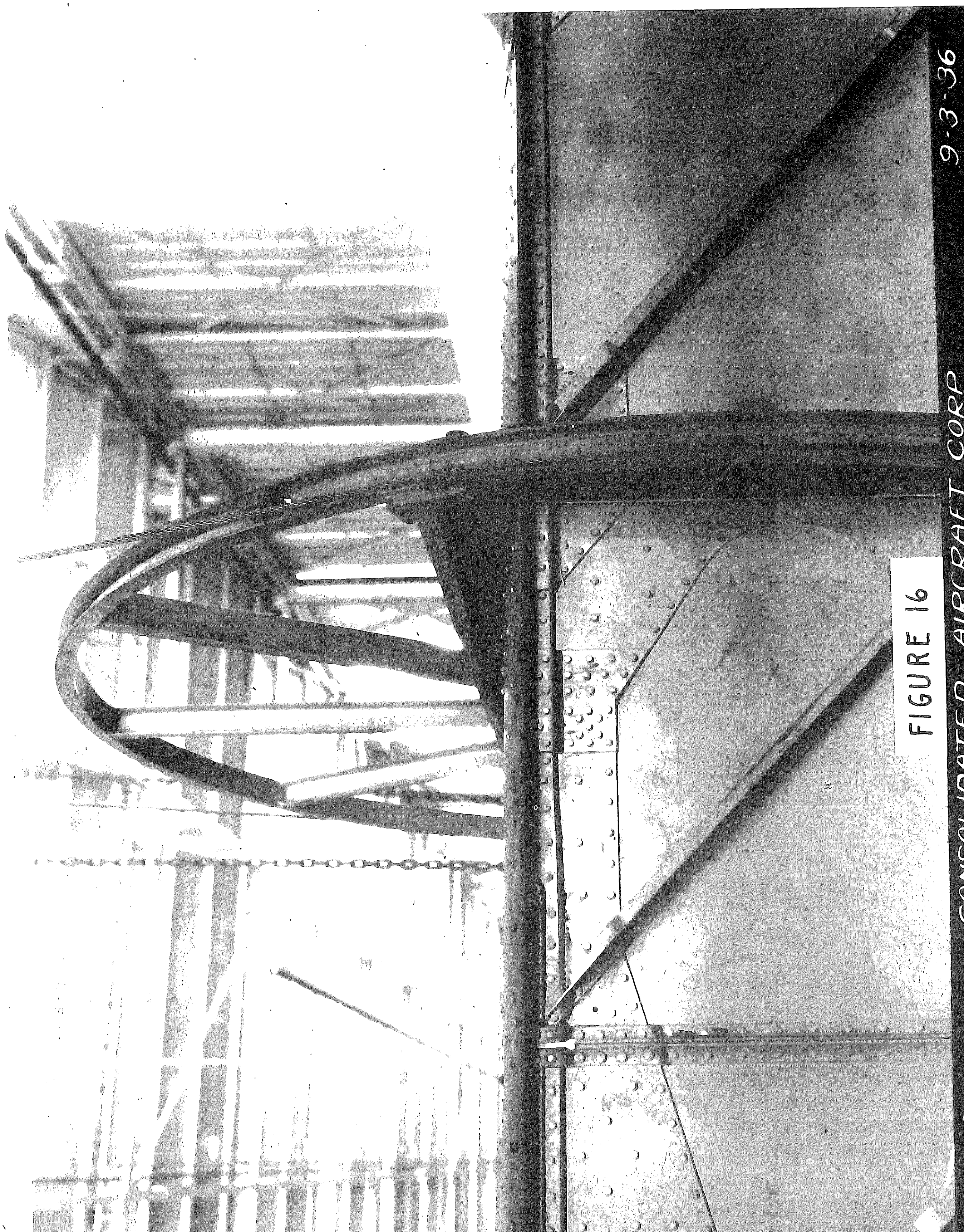


FIGURE 16

NO 10028 CONSOLIDATED AIRCRAFT CORP 9-3-36
CLOSE-UP VIEW OF TURNING RINGS - SHOWING
CABLE ONE COMPLETE TURN AROUND WHEEL

The entire center section forward of the rear spar including the leading edge, is braced for walking.

### 12. Provision for Climbing on Wing (Ref. C.A.C. Drawings 28W138 and 28W171)

Hand grips are provided on each side of the wing centerline. Pull up on the grips to use.

## B. Empennage

### 1. General Description (Ref. C.A.C. Dwg. 28T5001; Figure 17 )

The empennage is of aluminum alloy, cantilever construction. The rudder and elevators are fabric covered. The lower fin is an integral part of the hull. The complete upper fin and stabilizer assembly is an assembled unit and attaches to fittings on the top of the lower fin. The rudder and elevators are installed after the upper fin and stabilizer assembly.

### 2. Attachment of Tail Surfaces (Ref. Figures 17 , 18 and 19)

#### a. Stabilizer and Upper Fin Assembly (Ref. C.A.C. Drawing 28T2029-105)

The stabilizer and upper fin assembly weighs approximately 250 pounds. It shall be assembled to the lower fin as follows:

(1) Hoist assembly over lower fin.

(2) Remove clevis pin guards from pulley bracket in small side hole at top of hull fin structure.

(3) Feed elevator tab control cables from stabilizer through this pulley bracket. Replace clevis pins.

(4) Lower stabilizer assembly on spacers attached to lower fin. (See C.A.C. Drawing 28T5001).

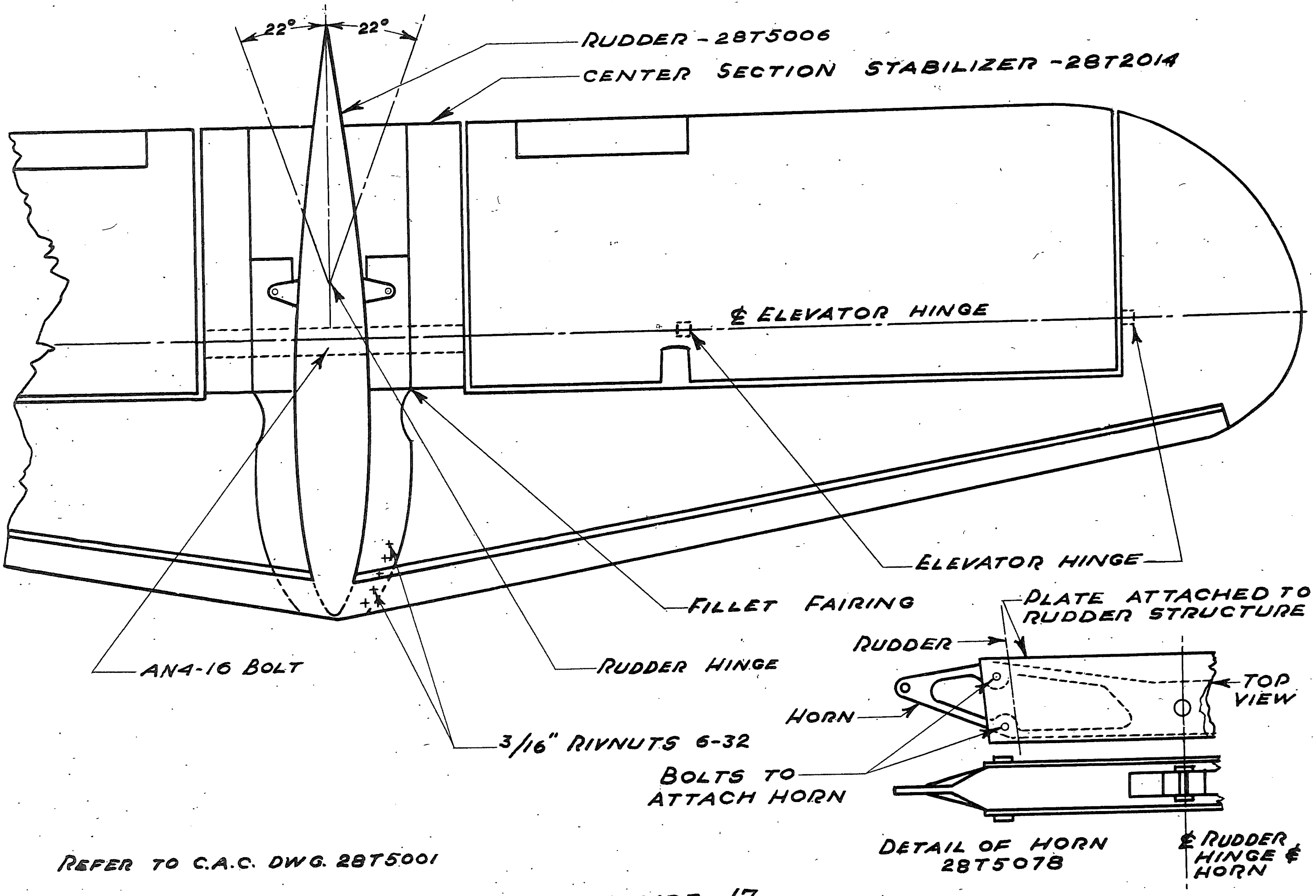
(5) Install bolts through auxiliary fittings between spars and also forward of front spar. Insert bolts through rear spar fittings.

(6) Insert bolts through front spar fitting, working through access holes on top surface of stabilizer. Tighten and cotter nuts on spar fittings. Safety the wire.

(7) Check stabilizer and fin according to Figures 18 and 19.

CAUTION: Extreme care should be taken to align the centerline of the stabilizer and the centerline of the elevator to prevent interference between the elevator horn and the cut-out in the stabilizer rear spar. This alignment can be accomplished by means of the adjustable tip hinge supports.

Total allowable elevator trailing edge misalignment (vertical) between any two points, one point on each elevator, shall not exceed 5/8 inch.



REFER TO C.A.C. DWG. 28T5001

FIGURE 17
EMPENNAGE INSTALLATION

b. Rudder (Ref. C.A.C. Drawing 28T5005, Fig. 17)

Because of the center section of the stabilizer that extends through the rudder, the following procedure is necessary to install the rudder:

(1) Remove rudder horn from rudder and attach horn to center hinge bracket with pin bolt (head down) through center. Cotter the bolt.

(2) Remove the upper hinge plate from rudder and attach hinge plate to upper fin with pin bolt (head up) through center. Cotter the bolt.

(3) Remove screw from removable part of stabilizer section. Remove section.

(4) Remove stabilizer section in rudder slot. Move rudder forward into place.

(5) Check hinge fittings for correct vertical adjustment. Adjust hinges to fit by removing through-bolt in base fitting and turning adjusting stud with screw driver. Move rudder clear of fin to make adjustment.

(6) Replace locking bolts and again move rudder into position. Make certain that stabilizer section is in place in slot.

(7) Attach rudder to rudder horn with 4 bolts - 2 on each side.

(8) Attach rudder to top hinge plate with 2 bolts - 1 on each side.

(9) Tighten and lock-wire all bolts.

(10) Connect rudder and tab control links.

(11) Bond at rudder top hinge - not at bottom hinge. The rudder middle hinge is bonded by conduit. The bond at the elevator tip hinges and elevator middle hinge is by cable. See C.A.C. Bonding Report 28E4027 for additional bonding information.

(12) Reattach stabilizer section to stabilizer center section. This part must be placed in slot before moving rudder into position.

(13) Check rudder throw and clearance according to Part C of this section and Figures 18 and 19 .

(14) Perform the following operations for the electrical installation:

(a) Pass flexible conduit from rudder through neoprene grommet on center hinge bracket. Replace fairlead.

(b) Remove cover from terminal box on stern post and pass wires through fitting on cover.

(c) Connect wire to terminal studs in box which carry correspondingly marked numbers.

(d) Screw coupling nut on cover fitting. Coil slack wire into box and replace cover.

(e) Connect bonding braids at each of two rudder hinges.

(f) See also C.A.C. Bonding Report 28E4027.

c. Elevators (Ref. C.A.C. Drawing 28T2003 & Figure 17)

To install the elevators:

(1) Remove access plates from rear face of beams and slide them back along the tab control push-pull tube.

(2) Place tip hinge supports at outboard end of elevators.

(3) Remove screws in aft stabilizer section. These plates are on top chord of this section and hinged on one side to prevent their loss. Lay these plates back out of the way.

(4) Move elevators into position. Bolt intermediate hinges and insert two stud bolts loosely into each tip hinge support.

(5) Bolt elevators to horn with four bolts through elevator plates.

(6) Align tip hinge supports to bring all hinges into line. Tighten the end bolts. A uniform space should appear between elevator leading edge and gap fairing.

(7) Connect rudder control assembly according to Section IV, Part L-3-c.

(8) Check rudder movement and clearance according to Part C of this Section and also Figures 18 & 19.

(9) Remove bolt which connects elevator push-pull tube and elevator horn. Check for ease or movement for 5° up and down over-travel of elevator. Replace bolt. Tighten and cotter.

(10) Insert two remaining bolts at each tip hinge, with longer bolt holding bonding braid clip opposite clip on elevator. Tighten and cotter all bolts and nuts.

(11) Join bonding braids at tip hinges and at each intermediate hinge. Replace all access hole cover plates.

(12) Replace plates in stabilizer section. Tighten all screws.

(13) Access doors and cover plates are shown on Fig. 21.

d. Fairing (Ref. C.A.C. Drawings 28T1026, 28T2026, 28T5067)

(1) Afairing is provided between the elevator nose and the stabilizer, to reduce air leakage between these two surfaces. (C.A.C. Drawing 28T2044). Adjust fairing to give approximately 1/8" clearance. Safety the wire.

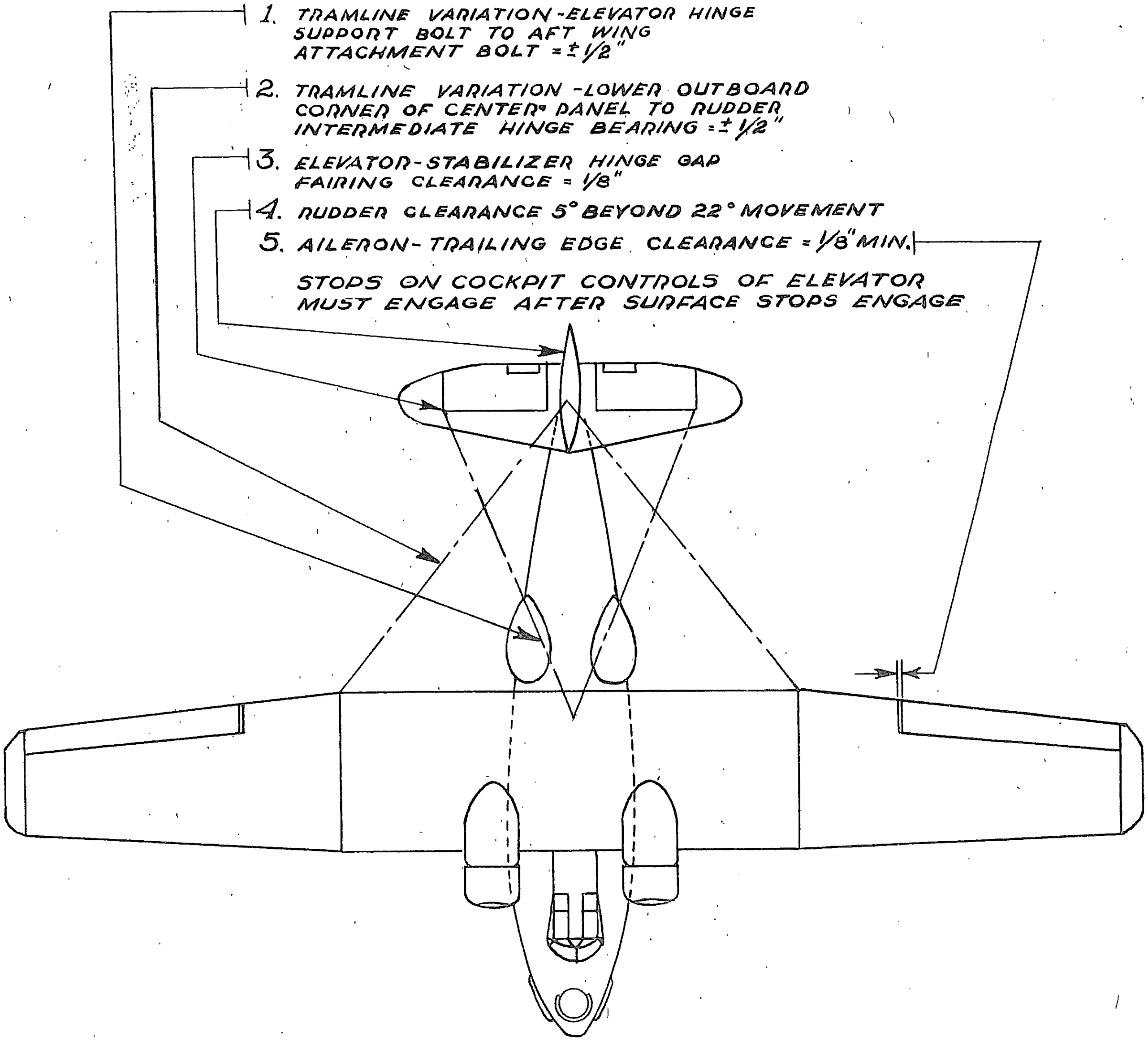
(2) Install upper and lower aft fillet fairing. Install nose fillet fairing. Refer to C.A.C. Drawing 28T1026 for screw attachment.

(3) Install remaining fairing (C.A.C. Drawing 28T5067)

C. Rigging Data (Ref. C.A.C. Drawing 28Z5014)

| | | |
|---|---|---|
| Dihedral (on top surface of wing) | 0° | |
| Incidence of Wing | + 6° | ± 1/2° |
| Elevator Throw | | |
| Up | 30° | ± 1-1/2° |
| Down | 20° | ± 1-1/2° |
| Stabilizer | Fixed | |
| Incidence | + 4° | ± 1/2° |
| Rudder Throw | | |
| Left | 22° | ± 1° |
| Right | 22° | ± 1° |
| Aileron Throw | | |
| Up | 21° | ± 1-1/2° |
| Down | 19 3/4° | ± 1-1/2° |
| Aileron Tab Throw | | |
| Up | 15° | ± 1° |
| Down | 15° | ± 1° |
| Elevator Tab Throw | | |
| Airplane Nose Up | 10° | ± 1° |
| Airplane Nose Down | 5° | ± 1° |
| Rudder Tab Throw | | |
| Left | 20° | ± 1° |
| Right | 15° | ± 1° |

NOTE:
#4 REFERS TO 28C5000
& 28T5001
#3 REFERS TO 28T2044



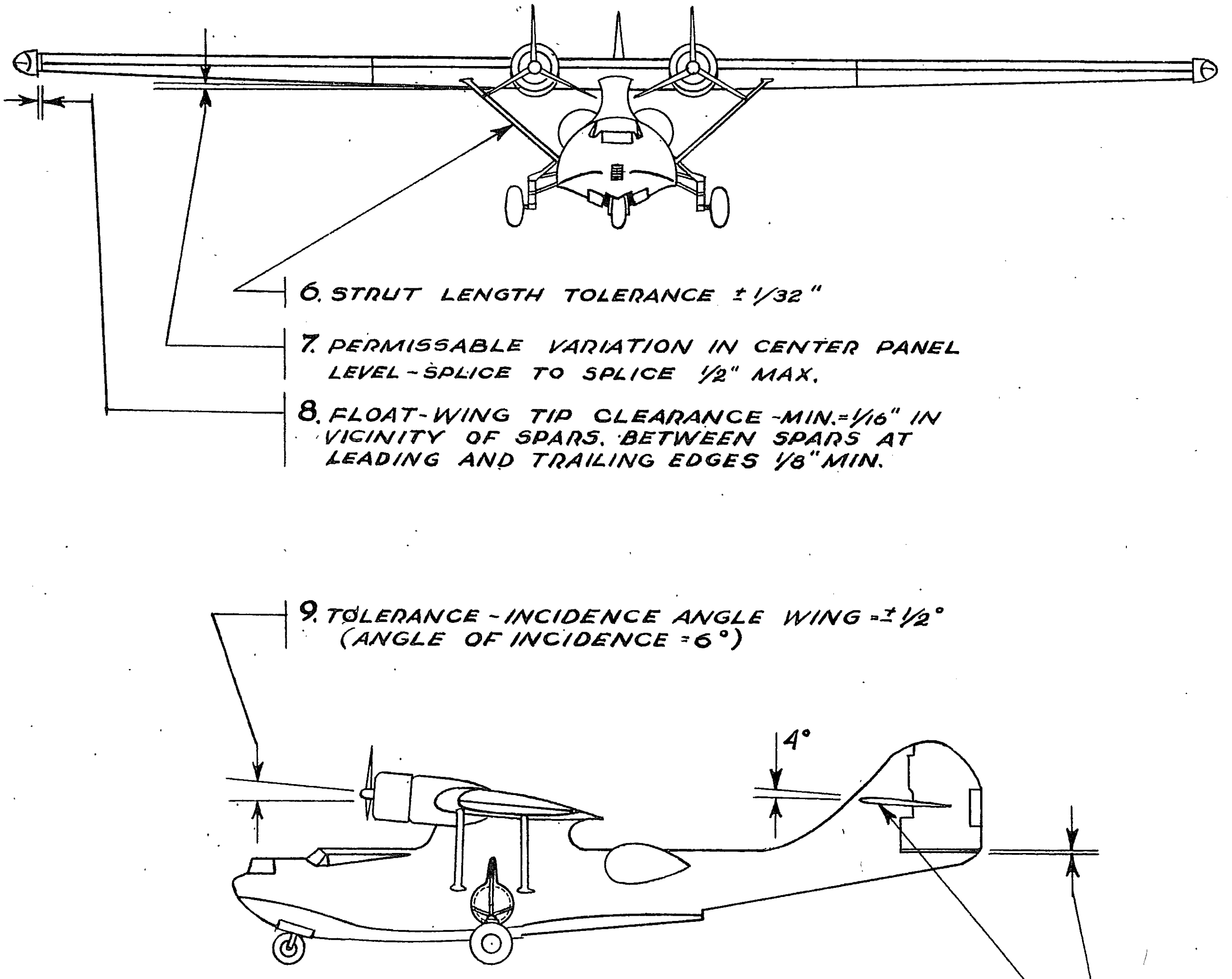
1. TRAMLINE VARIATION-ELEVATOR HINGE SUPPORT BOLT TO AFT WING ATTACHMENT BOLT = ± 1/2"
2. TRAMLINE VARIATION -LOWER OUTBOARD CORNER OF CENTER PANEL TO RUDDER INTERMEDIATE HINGE BEARING = ± 1/2"
3. ELEVATOR-STABILIZER HINGE GAP FAIRING CLEARANCE = 1/8"
4. RUDDER CLEARANCE 5° BEYOND 22° MOVEMENT
5. AILERON-TRAILING EDGE CLEARANCE = 1/8" MIN.

STOPS ON COCKPIT CONTROLS OF ELEVATOR MUST ENGAGE AFTER SURFACE STOPS ENGAGE

REFER TO C.A.C. DWG. 28R2044

FIGURE 18

RIGGING INFORMATION



6. STRUT LENGTH TOLERANCE ± 1/32"

7. PERMISSABLE VARIATION IN CENTER PANEL LEVEL - SPLICE TO SPLICE 1/2" MAX.

8. FLOAT-WING TIP CLEARANCE - MIN. = 1/16" IN VICINITY OF SPARS. BETWEEN SPARS AT LEADING AND TRAILING EDGES 1/8" MIN.

9. TOLERANCE - INCIDENCE ANGLE WING = ± 1/2° (ANGLE OF INCIDENCE = 6°)

10. RIG STABILIZER FIN A'SS'Y. AT 4° POSITIVE INCIDENCE - TOLERANCE ± 1/2°

11. STABILIZER HORIZONTAL IN FRONT ELEVATION - TOLERANCE ± 3/4 AT STABILIZER TIP

12. MINIMUM RUDDER TAILCONE CLEARANCE = 3/4"

#10 REFERS TO 28T5004
STOPS ON COCKPIT CONTROLS OF ELEVATOR MUST ENGAGE AFTER SURFACE STOPS ENGAGE

REFER TO C.A.C. DWG. 28R2044

FIGURE 19
RIGGING INFORMATION

Surface Control Cable Tensions

| | |
|---|---|
| Elevator System | 90# |
| Rudder System | 90# |
| Aileron System | 90# |
| Trim Tab Systems | 25# |

## D. Landing Gear

The detailed description for the erection of the landing gear will be entered here when available. For detailed description for the removal of the landing gear, see Section IV, Part K.6.

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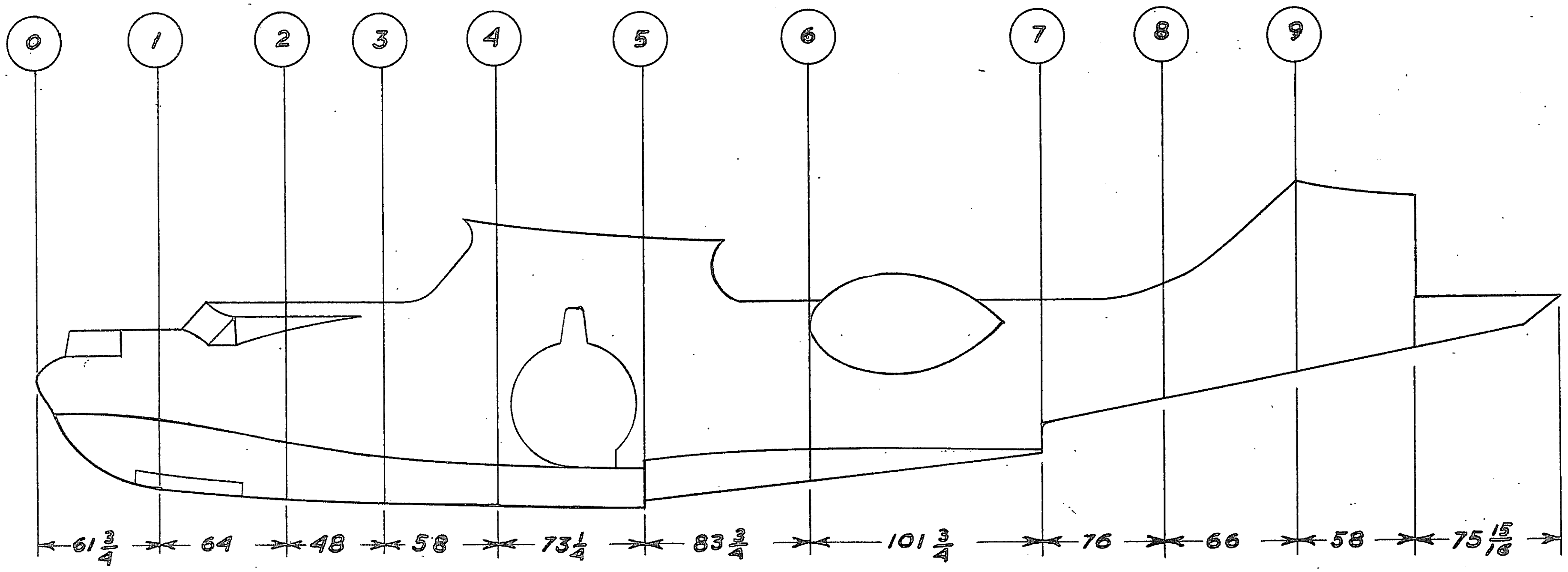
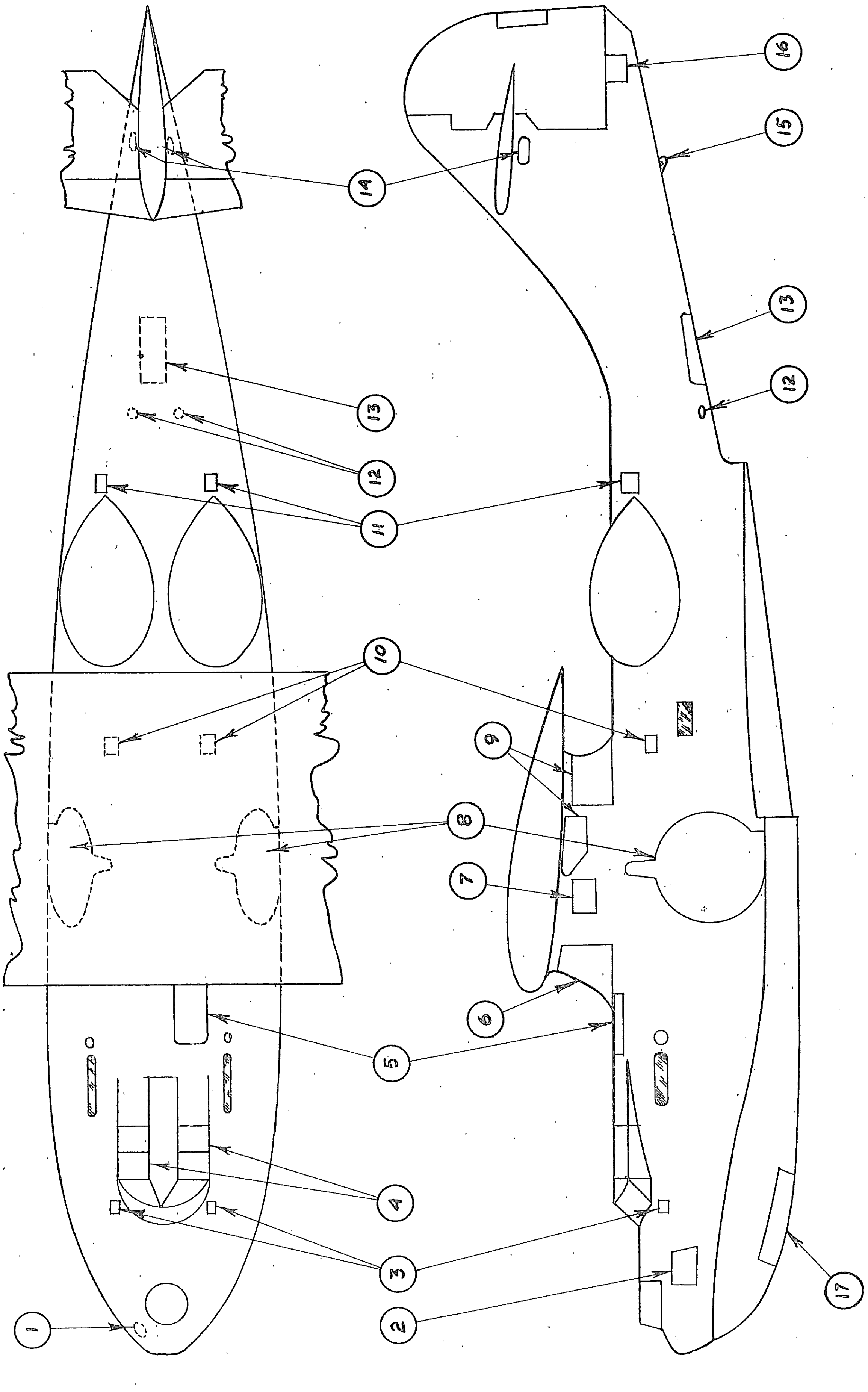
(C.A.C.)



REFER TO C.A.C. DWG. 28B004

FIGURE 20
HULL STATIONS DIAGRAM



REFER TO C.A.C. DWG. 28 B 5500

FIGURE 21
HULL ACCESS DOORS AND OPENINGS

1. Bomber's Window (Hand Hole)
2. Anchor Access Door
3. Ventilator Doors
4. Cockpit Access Sliding Panels
5. Navigator's Hatch
6. Removable Panels
7. Engineer's Sliding Panels
8. Main Landing Gear Wheel Wells
9. Access to Sump
10. Ventilator Doors
11. Access to Blister (Hand Hole)
12. Flare Release Openings
13. Tunnel Gun Openings
14. Doors For Empennage Control Inspection
15. Towing Fitting
16. Inspection Door
17. Nose Wheel Well

KEY TO FIGURE 21

HULL ACCESS DOORS AND OPENINGS

# SECTION IV

# SERVICE INSTRUCTIONS

## A. Introduction

All tubing shall be identified by painted bands in accordance with the color specifications as shown in Figure 33.

## B. Power Plant

### 1. Description (Ref. C.A.C. Dwg. 28P5100)

Each of the two power plants on the airplane consists of the following: One Pratt & Whitney R-1830-92 engine, engine mount, exhaust system, induction system and controls; a Hamilton-Standard propeller and controls, propeller anti-icer, starting system, fuel system, oil system, nacelle and engine cowling and controls.

Each power plant is mounted in a nacelle in the leading edge of the wing center section. The oil tank forms an integral part of each monocoque nacelle and is bolted to the wing structure. The engine mount, in turn, is bolted to the front face of the oil tank. The engine attaches to the engine mount through flexible pedestal mounts attached to the engine. Two fuel tanks are built integrally into the wing between the front and rear spars of the center section. Provisions are also made for the installation of self-sealing fuel cells which may be carried inside one or both integral tanks. Self-sealing interconnecting fuel lines are also provided. Engine controls are located at the engineer's station in the hull superstructure. The propeller and throttle controls are located in the pilots' compartment.

The power plant installations in the nacelles are shown in Figures 22, 23, 24, 25, & 28.

### 2. Engines

#### a. Description

The two engines are Pratt & Whitney R-1830-92 air-cooled radial engines with 16:9 reduction gears and a single stage, single speed geared type supercharger.

The engines are rated on 100 Octane fuel as follows:

1200 H.P. - 2700 R.P.M. at Take-Off
1050 H.P. - 2550 R.P.M. at 7500 ft.
1050 H.P. - 2550 R.P.M. at Sea Level

These engines have a decoupled or splined propeller drive.

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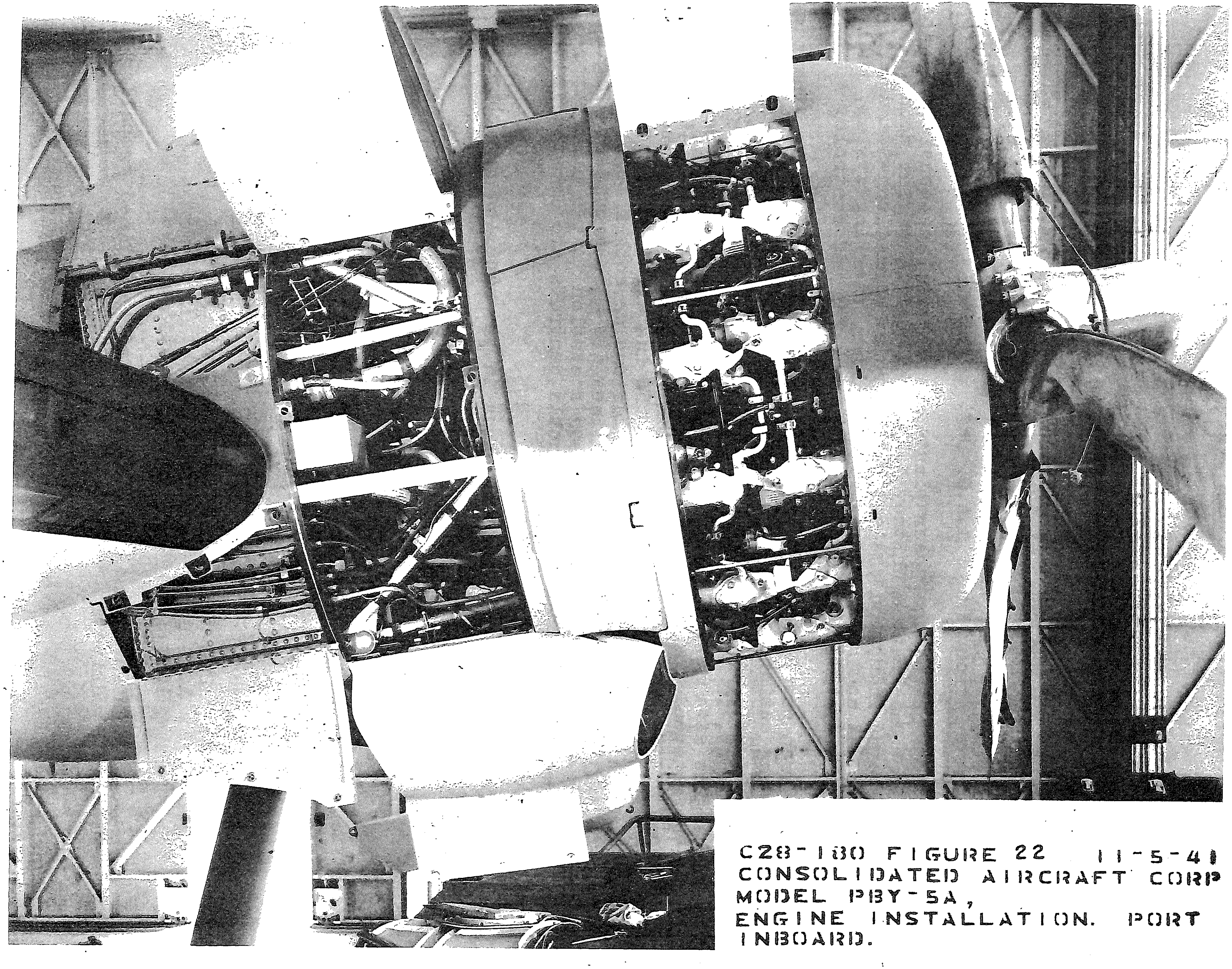
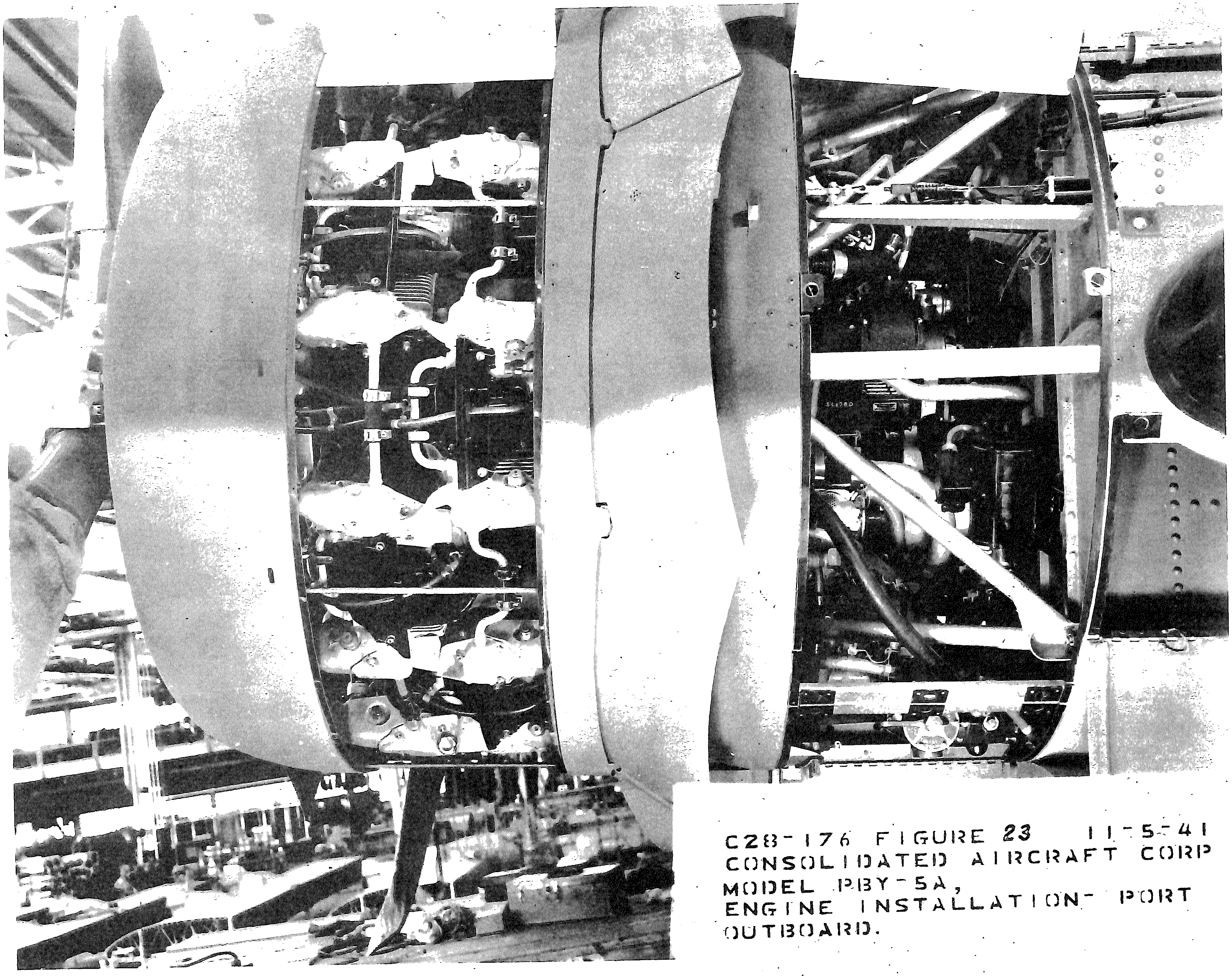
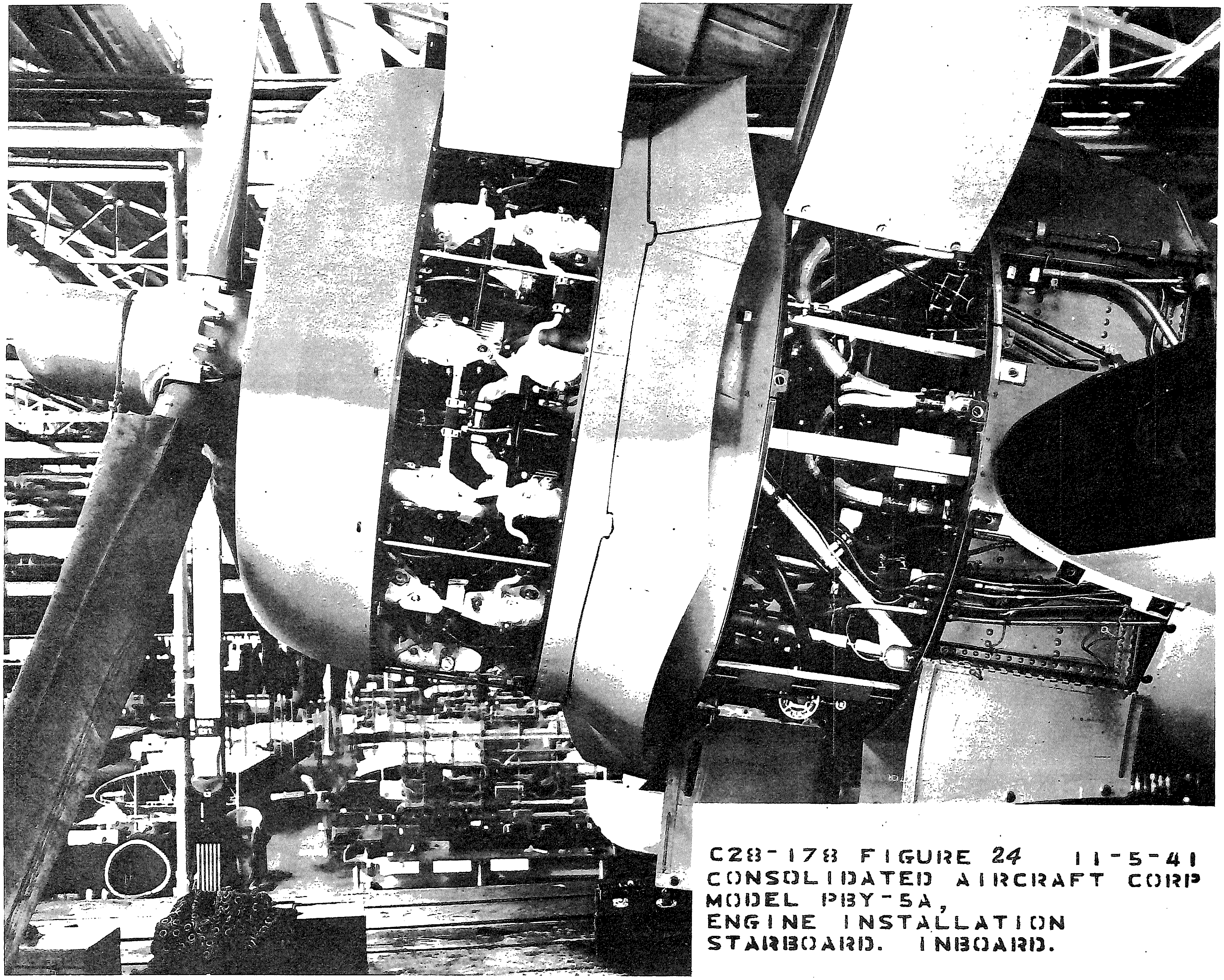


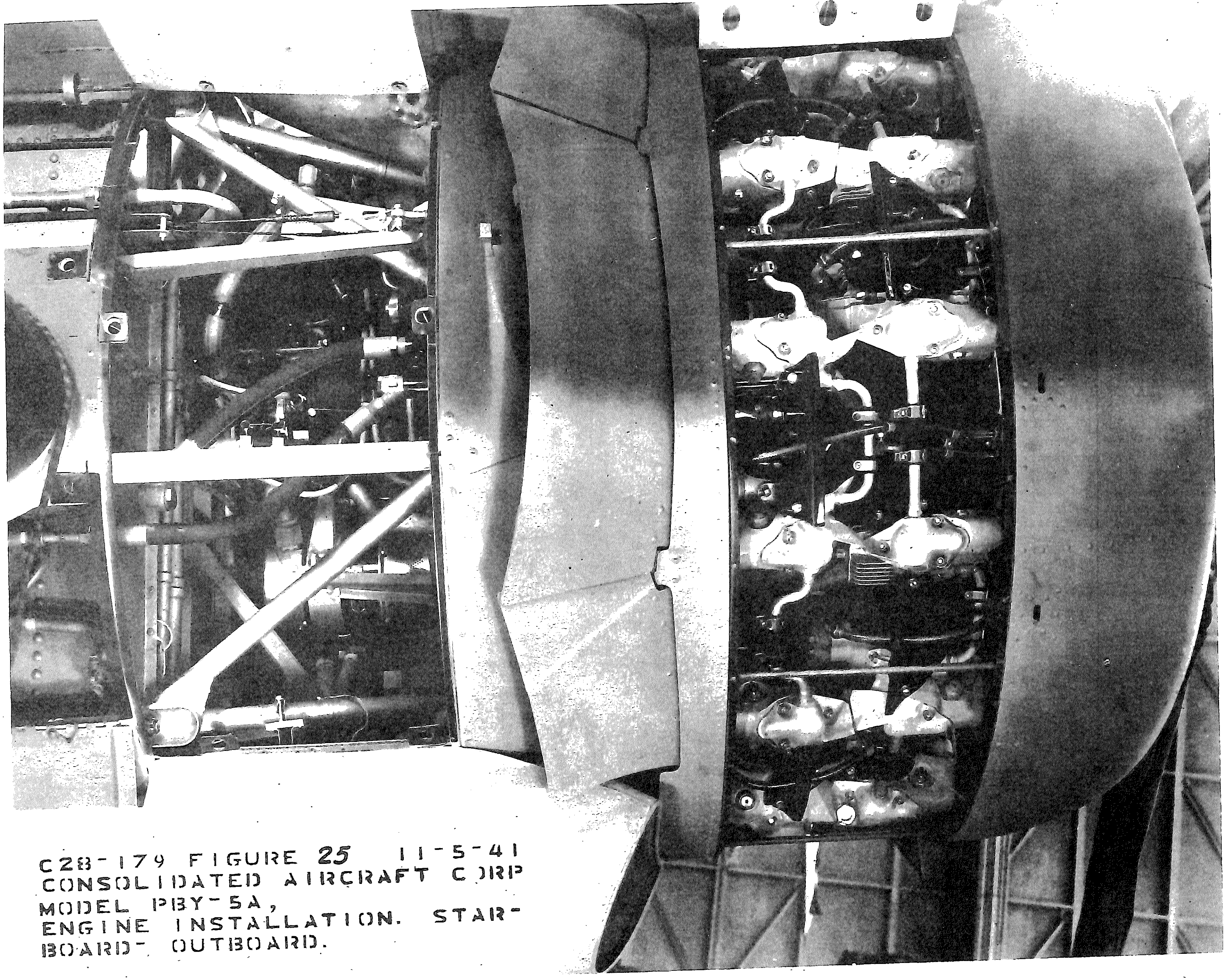
C28-180 FIGURE 22 11-5-41
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A,
ENGINE INSTALLATION. PORT
INBOARD.



C28-176 FIGURE 23 11-5-41
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A,
ENGINE INSTALLATION- PORT
OUTBOARD.



C28-178 FIGURE 24 11-5-41
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A,
ENGINE INSTALLATION
STARBOARD. INBOARD.



C28-179 FIGURE 25 11-5-41
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A,
ENGINE INSTALLATION. STARBOARD- OUTBOARD.

Each carburetor is a Bendix-Stromberg pressure injection down draft type PD-12H1. It is of a non-icing design, thereby eliminating the need of a preheater. For wing icing conditions, rain, sleet or snow, a protected source of air is provided which is available when the normal air intake duct is liable to be plugged with ice. Refer to Part A-5 of this section for the exhaust shroud description. An automatic mixture control controls the carburetor fuel metering.

Note: If upon overhaul the R-1830-92 engines are replaced by R-1830-82 engines, care must be taken to operate the R-1830-32 engines in accordance with their rating, given below:

| Rated BHP | R.P.M. | Altitude (Ft.) | Condition |
|---|---|---|---|
| 1200 | 2725-2750 | S.L. | Take-off |
| 1050 | 2450 | 5700 | Normal |
| 1050 | 2450 | S.L. | Normal |

Vibration analysis of the results of flight tests show that the peaks of certain of the vibration curves of the R-1830-82 engine and the Hamilton Standard Propellor used, fall in the engine speed range between 2450 and 2650 R.P.M. It is therefore necessary to restrict the engine operation to avoid or pass through quickly the range between 2450 and 2650 R.P.M. For details of operation of R-1830-82 engines refer to the Pilot's Handbook applicable to the PBY-5A airplace when equipped with R-1830-82 engines.

### b. Operation

Refer to the Pilot's Handbook for operation of the engine.

### c. Installation (Ref. C.A.C. Dwg. 28P5100)

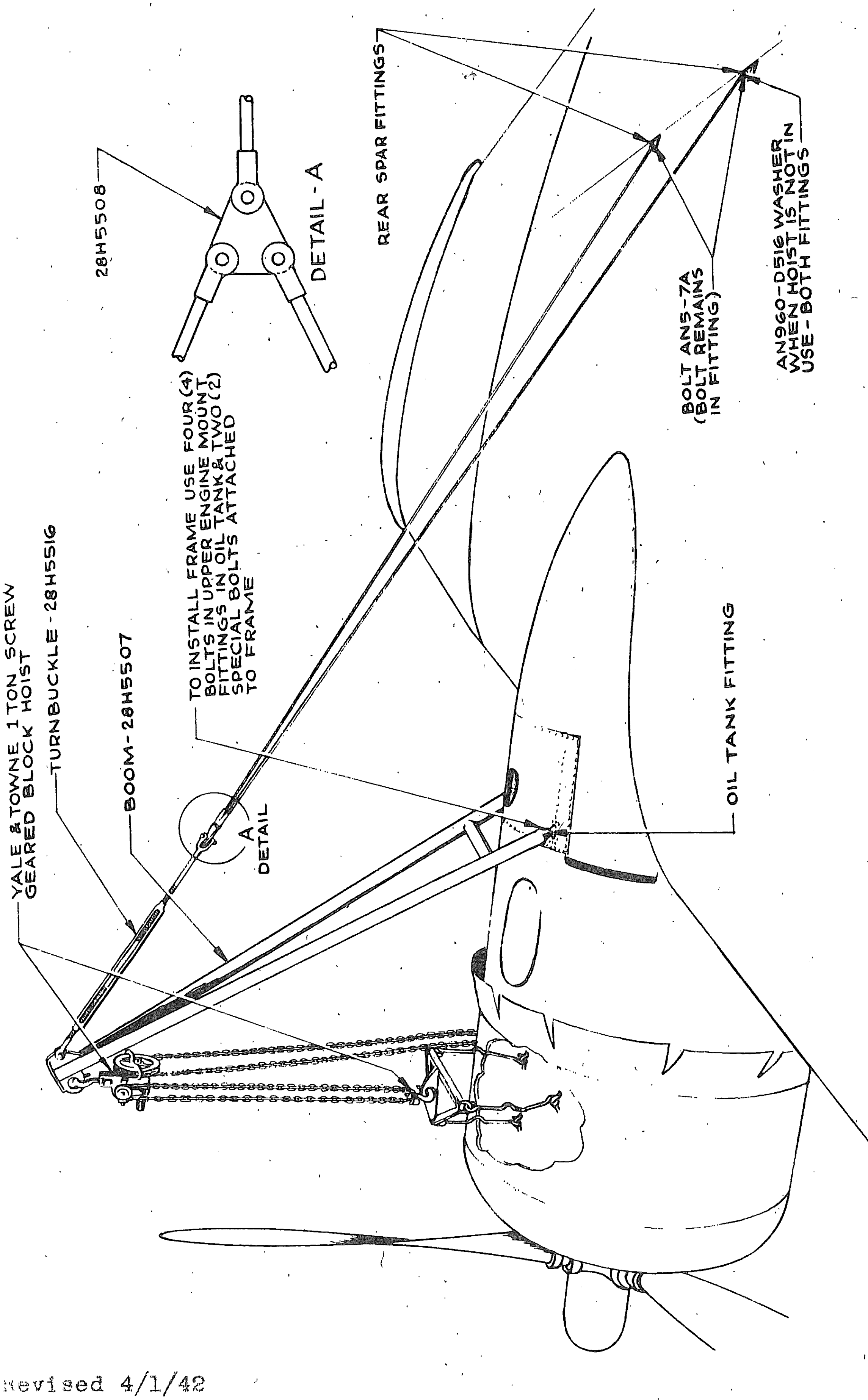
Each engine, which weighs about 1465 pounds, is hoisted by means of a portable engine hoist. The hoist shall be attached to the wing and oil tank structure as shown in Figure 26. When connecting the cables to the wing fittings, the washers should be removed as noted on Figure 26. Adjustments for the landing gear and water borne positions of the frame are made through the turnbuckle.

When installing the engines, the following procedure shall be followed:

(1) Install the exhaust collector shroud on the engine mount.

(2) Install the ring diaphragm 28P5001 on the engine pedestal mount studs (before installing the engine),

(3) Install the generator and starter on the engine.


YALE & TOWNE 1 TON SCREW GEARED BLOCK HOIST
TURNBUCKLE - 28H5516
BOOM - 28H5507
A DETAIL
TO INSTALL FRAME USE FOUR (4) BOLTS IN UPPER ENGINE MOUNT FITTINGS IN OIL TANK & TWO (2) SPECIAL BOLTS ATTACHED TO FRAME
28H5508
DETAIL - A
REAR SPAR FITTINGS
BOLT AN5-7A (BOLT REMAINS IN FITTING)
AN960-D516 WASHER WHEN HOIST IS NOT IN USE - BOTH FITTINGS
OIL TANK FITTING

REFER TO C.A.C. DWG. 28H5504

FIGURE 26
PORTABLE ENGINE HOIST INSTALLATION

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C.A.C.

(4) Attach engine to engine mount ring. Insert engine pedestal studs in engine mount lugs and tighten with nuts, exerting between 40 to 60 pounds pressure on a 12-inch wrench.

CAUTION: When tightening rigid mount base to engine crankcase, exert between 30 and 50 pounds pressure on a 12-inch wrench. When tightening the flexible pedestal mount to the rigid mount, exert between 40 and 60 pounds pressure on a 12-inch wrench.

(5) Install carburetor, vacuum pump, fuel pump and hydraulic oil pump.

(6) Make necessary electrical connections.

(7) Attach electrical accessory wires according to wiring diagram 28E5775; and check for polarity.

(8) Secure ground cable with bare terminals, under the most convenient nut on starter motor flange.

(9) Screw conduit coupling nuts tight. Fasten the conduit in clips provided on each engine nacelle as per 28E5030.

### d. Removal

To remove the engine, reverse the installation procedure. Disconnect plugs and break all lines at firewall.

## 3. Engine Mount

### a. Description (Ref. C.A.C. Drawing 28B5000)

The engine mount structure is made of welded chrome molybdenum steel tubing. Both engine mounts are identical and interchangeable.

### b. Installation

The engine mount is bolted to the front face of the oil tank at four points. No adjustment is needed - the mount being in alignment when the bolts are tightened.

CAUTION: Do not exert more than 65# pressure on the end of a 12" wrench when tightening bolts.

## 4. Exhaust System (Ref. C.A.C. Drawing 28P5048 & 28P5142)

### a. Description

The stainless steel exhaust system consists of two collector rings per engine with dual outlets at the top of the cowling. The rings are made up of sections bolted together by beaded clamp assemblies. Rain drains are provided at the bottom of the rings, near the engine exhaust ports. The exhaust port extension pipes bolt against the ports and are secured to the engine by a single bolt. They are secured to the collector rings by the beaded clamp assemblies. The exhaust port extension pipes are in one piece, and permit the removal of a cylinder without removing the collector rings, by means of the beaded clamps.

b. Installation (Refer to Figure 62A)

Check parts with the installation diagram to insure that no parts are missing. As parts are checked lay them out on a flat surface in the general path of the assembly as shown on the diagram.

Install the nipples in their respective exhaust ports. Be particularly cautious to make sure that the two long nipples with the beaded ends (Parts #12-911-15-17) are installed in Cylinders #2 and #4, respectively, and that the short nipple with the unbeaded end (Parts #12-911-16) is installed in Cylinder #3. The proper installation of these three nipples is extremely important. On all other cylinders the long nipples with unbeaded ends are installed in the front cylinders, and the short nipples with beaded ends are installed in the rear cylinders.

The exhaust port stud nuts should be installed but do not tighten them at this time as it should be possible to move the nipples slightly in order to properly align them with the manifold sections.

Spread all clamps apart just enough to slip them over the beaded end of the part to which they attach. If both parts have beaded ends the clamps may be slipped over either part. In either case, slide the clamps far enough onto the parts to be temporarily out of the way when the manifold is assembled on the engine. All clamps should be so installed on the parts prior to assembly of the manifold, as it is impossible to install the clamps after the assembly has been made. Be sure, of course, that double beaded clamps are installed at joints which have beads on each part to be joined.

Starting with any of the manifold sections, install the section on the nipples by aligning the section with the nipples and then slipping the nipple clamps into place. Bolts should then be installed in the double beaded clamps only (at this time), and these bolts should be tightened just enough to retain the section on the nipples. Mount all sections on the engine in this manner. Do not attempt to tighten any clamps or exhaust port stud nuts until the manifold is assembled on the engine. By installing the entire manifold loosely it will be found much easier to properly align all the parts with one another. When the entire manifold has been assembled on the engine, tighten the nipples securely to the exhaust ports by drawing the nuts up tight on the studs. Then proceed to adjust the clamps in accordance with the following instructions:

(Note: It is particularly important to follow these clamp adjustment instructions carefully, as the proper adjustment of the clamps is an important factor in obtaining proper service life from this exhaust manifold.)

The small double beaded clamps (Part #3-362-23S), which connect the manifold sections to the nipples, should be adjusted first. These clamps should be tightened until it is impossible to rotate the clamps by hand, but not so tight that they cannot be rotated by firm taps with a hammer. It is important that these double beaded clamps be kept tight at all times, as they are the only means by which the manifold is held to the nipples.

The small single beaded clamps (Part #3-295-23S) should then be adjusted. These clamps should be adjusted by drawing down the two bolts evenly until the clamp can barely be rotated by hand or very light taps with a hammer. Never tighten these clamps tighter than specified, as they are designed to allow for expansion of the front nipples.

The five large single beaded clamps (Parts #3-609-23S, -32S, -44S), which connect the manifold sections together, should be adjusted by tightening the bolts until the clamp bosses touch, but when these bosses are drawn snugly together it should be possible to barely rotate the clamps by hand. These clamps should not be adjusted any tighter than specified as they are designed to allow for expansion between the manifold sections. When the bosses are drawn together the nut should be backed off approximately one castellation in order to prevent putting undue strain on the bolts. If the bolts are tightened excessively when the clamps are cold the expansion of the clamp in operation will cause failure of the bolts. This is particularly true of the larger diameter clamps of this type.

Cotter keys must be installed in all clamp bolts.

c. Maintenance

Under normal conditions the exhaust system should require little maintenance. A periodic check is desirable to see that none of the clamp bolts have failed or that none of the nuts are loose. Do not re-tighten bolts which have been in service and appear to be loose. If at all possible, it is advisable to replace these bolts with new ones. If loose bolts are re-tightened there is a possibility of bolt failures during operation. Check also for possible fatigue failure or cracks in the manifold sections, clamps, and nipples. Cracks or fatigue failures in the nipple lugs should not be repaired in the field, but rather should be returned to the factory for replacement or repair. In event the clamps become excessively loose beyond the point of adjustment, material should be removed from between the bosses in order that the clamps may be properly adjusted.

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C.A.C.

The entire exhaust system should be carefully checked periodically for cracks or failures. Cracks and failures of exhaust equipment generally fall into two classifications:

(1) Minor cracks resulting from vibration.
(2) Complete breaks resulting from extreme vibration or from failure to repair minor cracks.

Minor cracks may be temporarily stopped by drilling a small hole at each end of the crack. This hole should be not less than 1/16" or more than 1/8" in diameter, and should be drilled 1/8" from each end of the crack in the direction in which the crack is occurring. Close examination of the crack should be made in order to definitely determine the length of the crack. It should be borne in mind that this type of repair should be used in an emergency only and is definitely not to be classed as a permanent repair. Permanent repairs must be made as soon as possible.

Permanent repairs should be made in accordance with the following instructions:

Remove the damaged section and completely clean the material in the vicinity of the failure, both inside and out. Cleaning can be accomplished by pickling and sandblasting or by sanding with sandpaper. Do not attempt to burn off scale. It is imperative that the material be completely cleaned before any welding is attempted. Remove any parts that prevent proper cleaning. Do not passivate.

Materials required for satisfactory repair are:

(1) Light duty oxy-acetylene welding equipment.
(2) Oxweld Cromaloy Flux.
(3) Welding rod equivalent to 18-8 stabilized stainless steel of 1/16" diameter (Columbium stabilized preferred.)
(4) Acid swab type brushes
(5) Ordinary shop equipment such as steel dollies or stakes which will fit the inside of the section to be repaired. Also hammers and grinding equipment or files.

Welding should be done using a stainless steel welding rod, and any patches that may be attached should be of Stainless Steel, Type #347. Attempting to weld with an ordinary iron welding rod or to attach patches of mild steel will not provide a serviceable repair.

When ready to weld, paint the inside surface with two coats of Oxweld Cromaloy Flux mixed with shellac to a molasses consistency. Let each coat dry. The shellac should be of the first quality, white, and thinned with one part of alcohol to two parts of shellac. Do not mix more flux than is required for the work at hand. The flux paste is most readily applied with an acid swab type brush. If care is exercised, flux may be dried with a torch.

Use as small an oxy-acetylene flame as will supply sufficient heat to produce good fusion. Excess heat will simply aggravate buckling. Use a soft slightly reducing flame (slight excess of acetylene). Feather or second cone should not extend more than 1/16" beyond the inner cone. The rod should be held in the flame at all times, or at least in the protective gases, to prevent the oxidizing of the molten globule on the end of the rod before it is placed in the weld. The metal should not be puddled with the end of the rod. The tip of the inner cone of the flame should be held at least 1/8" from the pool of molten metal, thus preventing oxidation. The angle of the blowpipe flame should be about 80 degrees off horizontal.

If the crack is over 2" long, tack weld crack together with half inch and smooth with a hammer before fluxing and welding. Start the weld at the inside end of the crack and weld steadily to the end of the section. A crack within a section should be started in the middle and welded toward the ends. Finished welds should extend approximately 1/4" beyond the crack to insure a solid job. In finishing the weld the flame must be drawn away from the material slowly, so that the heat may be dissipated throughout the section. Place the repaired section over a dolly or stake held in a vise and hammer lightly to relieve the tension stresses after the section has cooled. Grind or file weld only as necessary to permit reassembly. Remove weld ends overhanging end of repaired section.

In the case of a complete failure, such as breakage of a flange from a section, it will be necessary to tack weld the section in place after cleaning. Move the broken section apart 1/16" before tack welding to permit proper alignment of finished section. Smooth the joint with a hammer and weld as outlined above. Best results will be obtained by making a half circular weld in one direction and completing by welding the other half in the opposite direction.

When a piece is missing from a section requiring a patch, patches should be made from 18-8 stabilized Stainless Steel sheet of the same gauge as the manifold section. Fit patches to give approximately 1/8" lap over the section. Care in fitting such patches will insure good results as long as preparation indicated above is followed.

A very satisfactory stake for supporting welds to be hammered can be made from round steel bar 1 1/4" to 1 1/2" diameter curved to fit the inside of the manifold section. Sufficient material should be left outside the curved section to permit gripping in a vise.

Revised 4/1/42
C.A.C.

L S WODHAMS 4-14-41

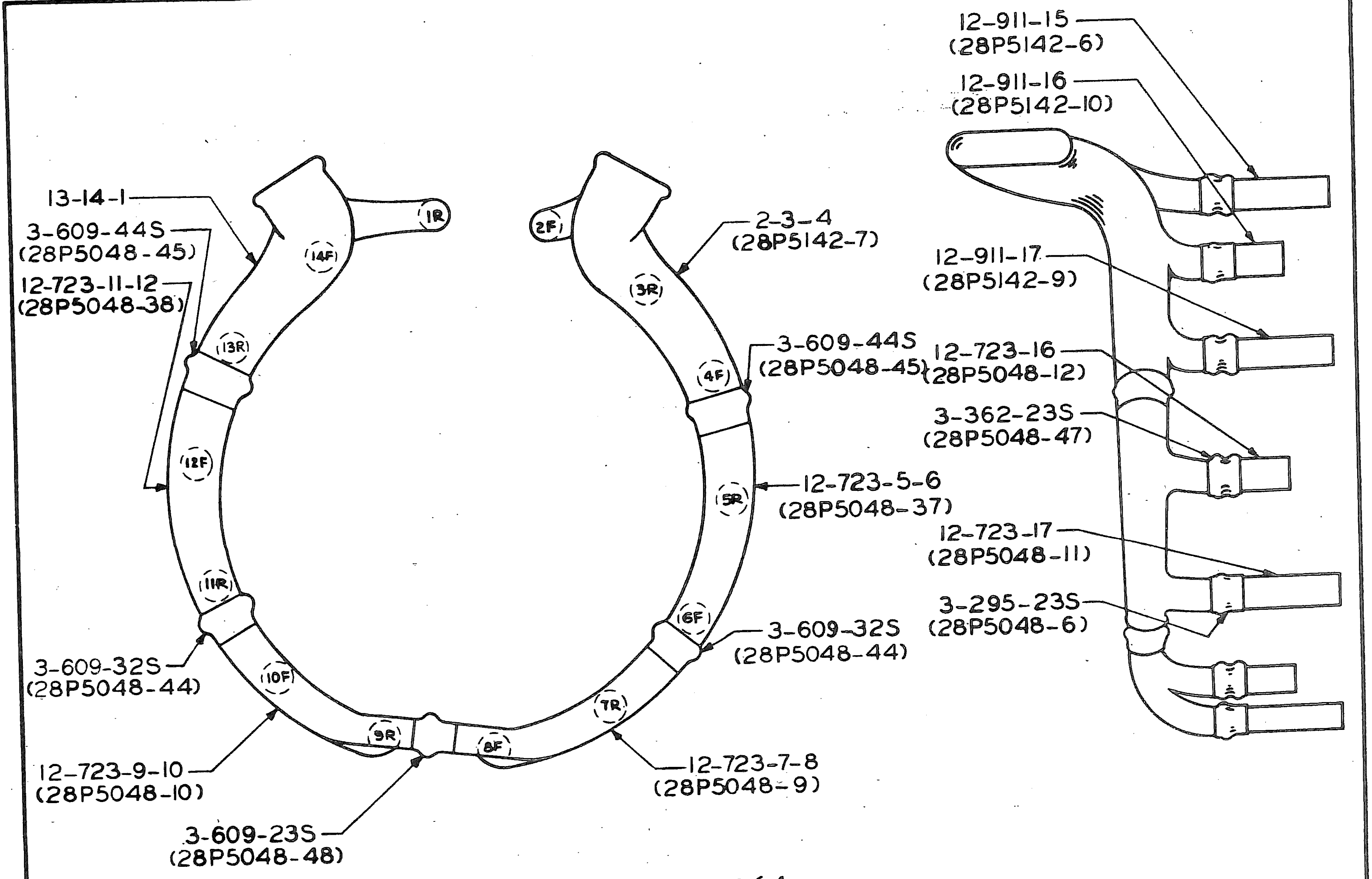
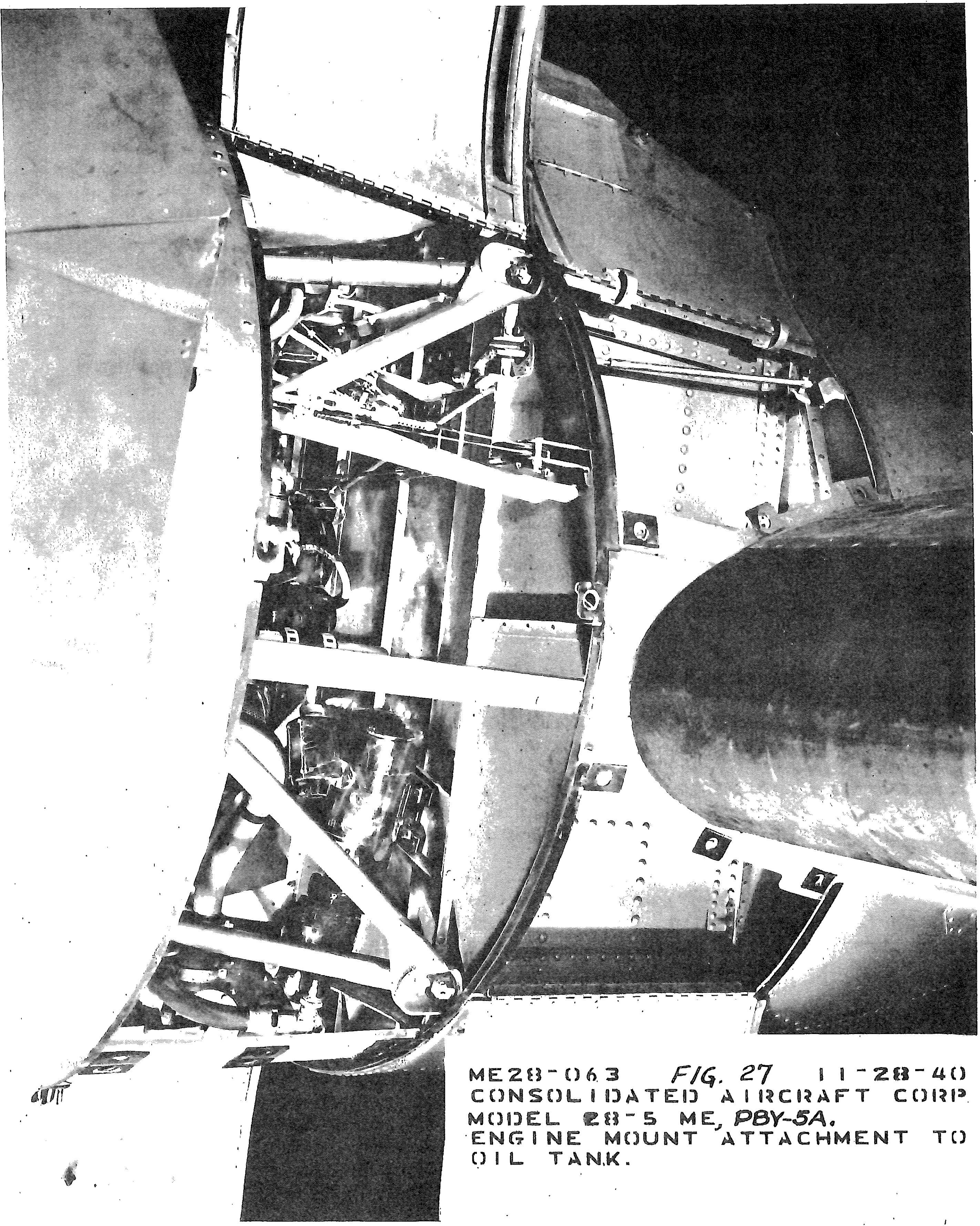


FIGURE 26A
MANIFOLD ASSEMBLY

Revised 4/1/42
C.A.CA



ME28-063 *FIG. 27* 11-28-40
CONSOLIDATED AIRCRAFT CORP.
MODEL 28-5 ME, *PBY-5A.*
ENGINE MOUNT ATTACHMENT TO
OIL TANK.

## 5. Exhaust Shroud

### a. Description (Ref. C.A.C. Drawing 28P5003)

A stainless steel exhaust shroud is attached to the front face of each engine mount by clamp assemblies. Its function is to cool the exhaust collectors and to protect the engine compartment from heat. A protected air intake door is installed on the carburetor air scoop at the inside top of the engine cowling for use with the non-icing carburetor.

### b. Installation

(1). Attach preheater to engine mount ring.

(2). Place ring diaphragm (28P5001) on pedestal mount studs.

(3). Engine may now be placed on engine mount.

## 6. Cowling

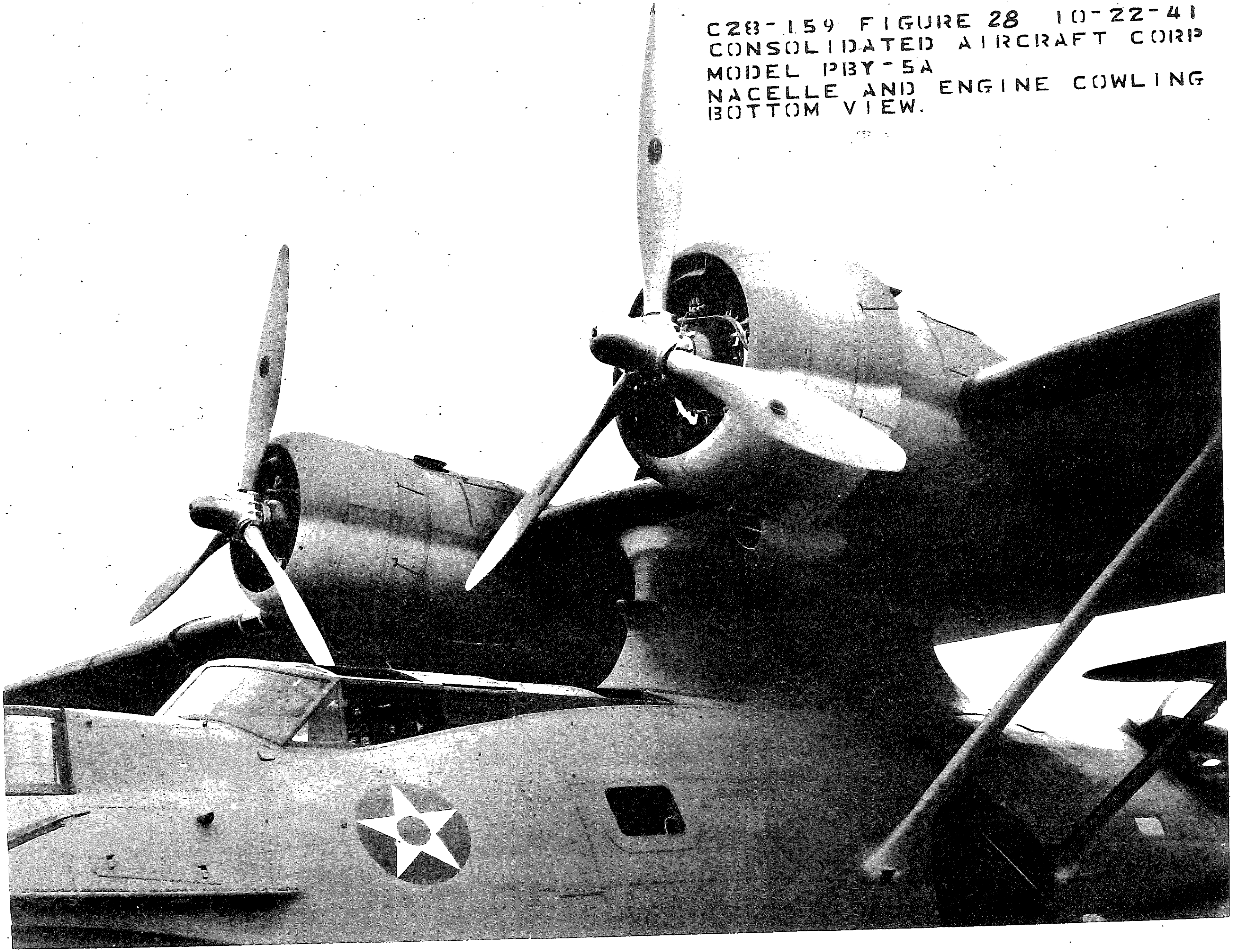
### a. Description (Ref. C.A.C. Drawing 28D5000)

The aluminum alloy sheet cowling is divided into two sections. The N.A.C.A. engine cowling which consists of the nose ring, the wrap cowl and the cowl flap assembly; the nacelle cowling which consists of the cowling aft of the cowl flaps.

The nose ring cowling is attached with rubber bushings to brackets on the face line of the rocker boxes. The mid section (engine wrap cowl) may be readily detached by loosening the turnbuckle bolts. It has a section of felt enclosed in fabric that prevents leakage of air past the deflector baffles. This section wraps around and rests on the edges of the fore and aft sections of the engine nacelle. The cowl flap assembly is attached to the aft line of the rocker boxes in a similar manner to the nose ring support attachment.

The cowl flap assembly has seven interconnected flaps, hinged to the cowl skirt. They are operated from the engineer's compartment. Their purpose is to improve cooling by opening up the flaps under varying conditions of climb, take-off, and level flight.

Access to the engine accessories is readily obtained through the removable and hinged sections of the nacelle cowling. See Figures 27 and 28 . The front section of the nacelle cowling is clamped to the engine mount ring. The aft cowl doors of the nacelle cowling are hinged at the oil tank structure and are fastened at the lower edge with Dzus fasteners. The side doors of the front section are hinged at the exhaust troughs and fasten to the exhaust shroud and firewall flanges with Dzus fasteners. The top portion of the front section is fastened down with Dzus fasteners screws and anchor nuts.



C28-159 FIGURE 28 10-22-41
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A
NACELLE AND ENGINE COWLING
BOTTOM VIEW.

### b. Installation

The integral parts of the cowling mentioned above shall be assembled in the following order:

(1) Flap ring.

(2) Nose ring.

(3) Wrap cowl.

Refer also to Part "A" above for further details.

For removing the cowl, reverse the above procedure.

## 7. Cowl Flaps

### a. Description

The cowl flap assembly consists of 7 interconnected flaps hinged to the cowl skirt and operated from the engineer's compartment.

The control system consists of plungers (supported by bolts in each end of flap) interconnecting each flap. They are operated by means of cranks located below the engineer's instrument panel on bulkhead #4.0. The cranks operate the flaps through a double cable system.

### b. Operation

To open the flaps, turn the crank clockwise, until the operating nut reaches its stop. To close the flaps turn the crank in a counter clockwise direction until the crank stop is in its foremost position. The inboard flap which is connected to the push pull rod should be seated against the stop. The outboard rod-operated flap should be approximately 1/16" away from its stop. To secure these flap positions, make any necessary adjustments at the aft ends of the push-pull rods. Open the flaps half way and move them back and forth to remove any play in the cable system. Tighten the cable system to a tension of 40#, making certain that the original adjustment has not been altered. The flaps are full "OPEN" at approximately 30° from the closed position, requiring 14 turns of the operating crank at approximately 2° per turn.

### c. Installation

The controls to the cowl flaps can best be installed when the rear section of the ring cowl containing the flaps and the front section of the nacelle cowl are in place. The cables should be attached to the control assembly (28P1100) on the rear of the engineer's panel and run up through the superstructure pulleys as indicated on Figure 31, out the spar to the nacelles and thence through pulleys indicated to arm operating flaps. When removing nacelle unit, disconnect the cables at the special disconnect fittings.

Revised 4/1/42
C.A.C.

d. Adjustment

To adjust cables, turn crank to the left (direction to "CLOSE" flaps) until handle comes to a stop. Tighten and adjust cables by means of turnbuckles, located in the wing leading edge at the quick disconnect fittings ahead of the firewall, and at the threaded ends of the push-pull rods connected to the flaps, to hold flaps in normal "CLOSED" position.

e. Maintenance

The cowl flap screw and operating nut must be greased frequently with a tenaciously clinging grease to insure ease of operation. (See Lubrication Chart, Section VI.)

8. Propellers

a. Description

Each airplane is equipped with two Hamilton-Standard, Hydromatic, full-feathering propellers. They are three bladed, of forged aluminum alloy, twelve feet in diameter. The governor is a Hamilton Constant Speed, Model 4-L-11, controlled by the pilot.

For propeller controls, see paragraph 10-a of this Section.

b. Installation

(1) Preliminary Procedure

(a) Remove cap from end of propeller shaft.
(b) Unlock plug retaining nut inside of shaft and remove plug and gasket, if oil does not gush out.
If oil gushes, put only the plug back to hold oil till ready for valve assembly.
(c) See that screw in engine propeller shaft identifying master spline is tight.
(d) Check position of anti-icer nozzle in relation of slinger ring opening (use gauge if possible.)
(e) Safety wire anti-icer nozzle adjustment.
(f) See that master spline is on top.

(2) Installation Procedure

(a) Thoroughly clean engine crank shaft and propeller hub splines.
(b) Install the thread protector on engine shaft.
(c) Oil shaft and hub spline.
(d) Install rear cone on engine shaft --- have cone surface dry and free from oil.
(e) Check nut on crank shaft for fit.
(f) Install hub on shaft. Check anti-icer

nozzle for alignment as hub slides into position.

(g) Install shaft oil seal --- 1st, small flat metal gland, 2nd, composition seal gland (C type), 3rd, metal expander. Always use a blunt tool.

(h) Rotate blades of propeller until gear segment on end of blade shaft allows split cone to be installed.

(i) Put oil in grooves in split cone halves and apply anti-seize compound to threads of main nut. Wipe cone surfaces dry.

(j) Install main retainer nut --- use four foot bar. Apply 180 pounds pressure and strike with mallet to set.

(k) Install snap ring.

(l) Remove plug in end of crank shaft (unless previously removed) and install correct copper gasket.

(m) Install valve assembly (use caution --- cast aluminum). Use regular four foot bar and combination field wrench, applying about forty pounds pressure. Check piston rings as to equal stagger of slots. Oil rings lightly. Do not back up to align locking slots.

(n) Wire snap lock (locks main retainer nut to shaft and shaft to valve assembly.) Install so rotation tends to tighten lock, tail of locking ring should trail pin end.

(o) Rotate blades to stop --- leading edges forward. (Full feathering).

(p) Set dome to highest pitch. (Feathering) Check that dome is for the propeller to which it is to be assembled. (Low 17° - high 88°). Check that all screws are in dome flange and tight.

(q) Place dome, minus neoprene gasket in correct position on hub, (arrow matching arrow) and tighten lock ring snugly with banjo wrench --- mark lug on lock ring nearest to notch in hub --- also mark hub. Then remove dome and install rubber seal on dome. Bevelled edge of seal to point aft.

(r) Install dome with arrow matching arrow on hub for balance.

(s) Tighten large locking ring. (Threads into propeller hub). Tap dome lightly with palm of hand as threads are being tightened; when snug up, apply 180 pounds steady pull on four foot bar. WARNING --- Avoid any heavy pounding as it will cause damage --- use only a light tap.

(t) Install locking screw and cotter. Leave one prong of cotter straight.

(u) Rotate blades to low pitch --- until stops are hit --- use blade fork to rotate blades, check marks on blade, hub and hub shoulder to see that blades are synchronized.

(v) Install flat ring and plug in end of dome. Snug with 10 inch wrench.

(w) Install snap ring --- tail following pin end.

(x) Bend all three anti-icer nozzles so that tip has approximately .040 clearance from blade shank.

c. Feathering Check

To check for proper propeller operation, proceed as follows:

Shift propeller control from low pitch (high RPM) to high pitch (low RPM). Allow approximately two minutes for oil to pass through and change pitch of propeller. After two or more propeller governor change operations, note drop of RPM when changed from low pitch (high RPM) to high pitch (low RPM). Approximately 100 to 150 RPM.

To check for proper operation of the right hand propeller feathering proceed as follows:

Place generator switches in the "ON" position to help supply current to the fast feathering pump. Push feather button for right hand propeller in. Button should hold in until engine has slowed down to approximately 500 RPM. Propeller is in full feather position now and the button should kick out automatically. To unfeather, push button in and hold until engine has reached approximately 900 RPM. Release button and propeller will continue to return to low pitch position.

To check for proper operation of left hand propeller feathering proceed as follows:

Proceed with the feather check as outlined for the right hand propeller. While this operation is being accomplished, the right hand engine scavenging pump will have emptied the engine sump of oil that was used in feathering the right hand propeller and this propeller is now ready for its second feathering operation.

9. Propeller Anti-Icer (Ref. C.A.C. Dwgs. 28P5060, 28P5061 and 28P5125)

### a. Description

A slinger ring type anti-icer has been installed on each propeller. The alcohol-glycerine solution is supplied to the rings through lines leading from a tank installed on the port side, aft face of bulkhead #4.0. The lines run from the Pesco pump, installed under the tank, up through the superstructure, and along the wing to each nacelle and thence forward to the propeller. (See Figure 30). The tank has a capacity of three gallons of anti-icer fluid.

The Pesco pump, type 265-DA, is electrically driven and pumps the fluid to the slinger ring where it is deposited on the propeller blades by the ring. A rheostat control for controlling the output of the pump is located on the pilot's instrument panel.

### b. Operation

See Pilot's Handbook.

### c. Installation

Install the slinger rings to the propellers. Connect the lines. The lines are marked near the ends with a stripe of red paint between 2 white stripes. The supply tank should be filled with an anti-freeze solution consisting of 85 parts of a good grade

## 10. Propeller Controls

### a. Description

The controls are operated by the pilot from his station, as shown on Figure 31 . A double cable connects each control lever to the propeller control governor which is mounted on the gear housing of each engine. Movement of this lever causes an adjustment in a spring in the governor which regulates the propeller RPM by means of a valve in the oil line to the propeller. The control cables extend from the quadrant on the pilot's levers back along the under side of the hull deck to the front face of bulkhead #4, where they pass through pulleys and extend up through the superstructure fairing to the leading edge of the wing. At this point they pass through pulleys on the front spar and extend, two cables to each nacelle, along the front spar to the nacelles, as shown on Figure

### b. Installation

To connect propeller controls, join turnbuckles which are marked with propeller identification bands, as shown on Figure 32 . Turnbuckles are located in the hull just forward of bulkhead #4.

Connect the cable between the control handle in the pilot's compartment and the governor. The upper limit of travel of the stop on the pulley is limited by the governor itself and the cable should be so attached to the pilot's control that the stop in the governor is reached before the end of travel of the control lever. About 1/8 to 1/4 inch of leeway should be provided. Next, the engine should be run and adjustment in flight made as follows: With the airplane in steady, level flight regulate the control handle until the engine is turning 2750 RPM. Land without disturbing propeller control. Stop the engine and set the stop on the pulley at the governor to limit travel in the increased RPM direction to the point obtained as above. See Hamilton-Standard Service Manual No. 140A for further details (Page 58).

The Maintenance instructions given under engine controls also apply to the propeller controls.

If the engines tend to under rev. on take-off or over rev. in level flight, check the propeller controls to make certain that the full distance between the stops on the propeller governor can be traversed without interference from the stops on the control lever in the pilot's compartment, before consulting the propeller manual.

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c. Feathering Pump

A Pesco #R-280-BH motor-driven high-pressure propeller feathering pump is located on the front face of the firewall.

For more detailed information, see the Handbook of Instructions for Model 280-BH High Pressure Pesco Oil Pump.

The feathering control switch is forward of the throttle quadrant on the pilot's ceiling.

11. Propeller Hoist (Ref. C.A.C. Dwg. 28P1009)

The propeller hoist consists of a "A" brace, a one ton screw geared block hoist (block and tackle), a turnbuckle, clevis and two brace wires.

The "A" brace is attached to the upper surface of the nacelle by four bolts in the upper engine mount fittings (in oil tank) and two special bolts attached to the frame. From the turnbuckle, which is attached to the top of the "A" brace, the two brace wires extend aft each fastening to eyebolt fittings in the rear spar upper wing surface. The block hoist is hooked through the front hole in the top of the "A" brace. The bottom chain hook engages the triangular fitting. The lines in the triangular fitting attach to special fittings on the engine. See Figure 29 for propeller hoist installed.

The special nuts are to remain at all times on the engine. The propeller hoist, however, is to be dismantled when not in use.

12. Starters

a. Description (Ref. C.A.C. Dwgs. 28P5026 & 28P5109)

These airplanes are equipped with a Jack & Heintz (JH5D) starter for each engine. For information regarding the method of removal and remounting of booster coil, refer to Navy Technical Notes 23-41.

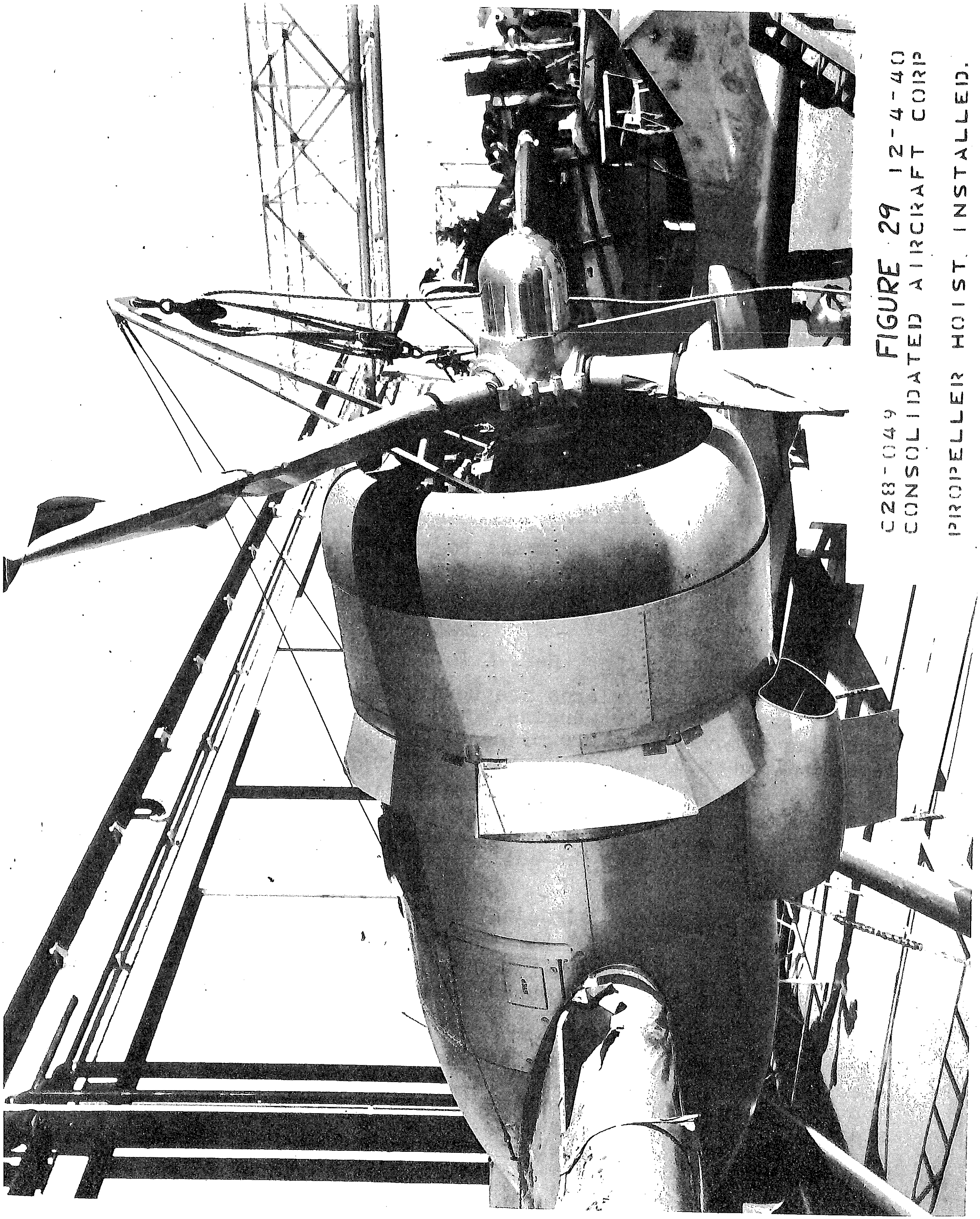
The starters have electric and manual controls. The switches for the electric controls are installed on the engineer's panel. There is a socket for the manual control crank on the top of the nacelle between the collector outlets on the port side of the airplane.

The manual engaging control is also on the port side of the nacelle at the oil tank under the hinged oil tank cowling.

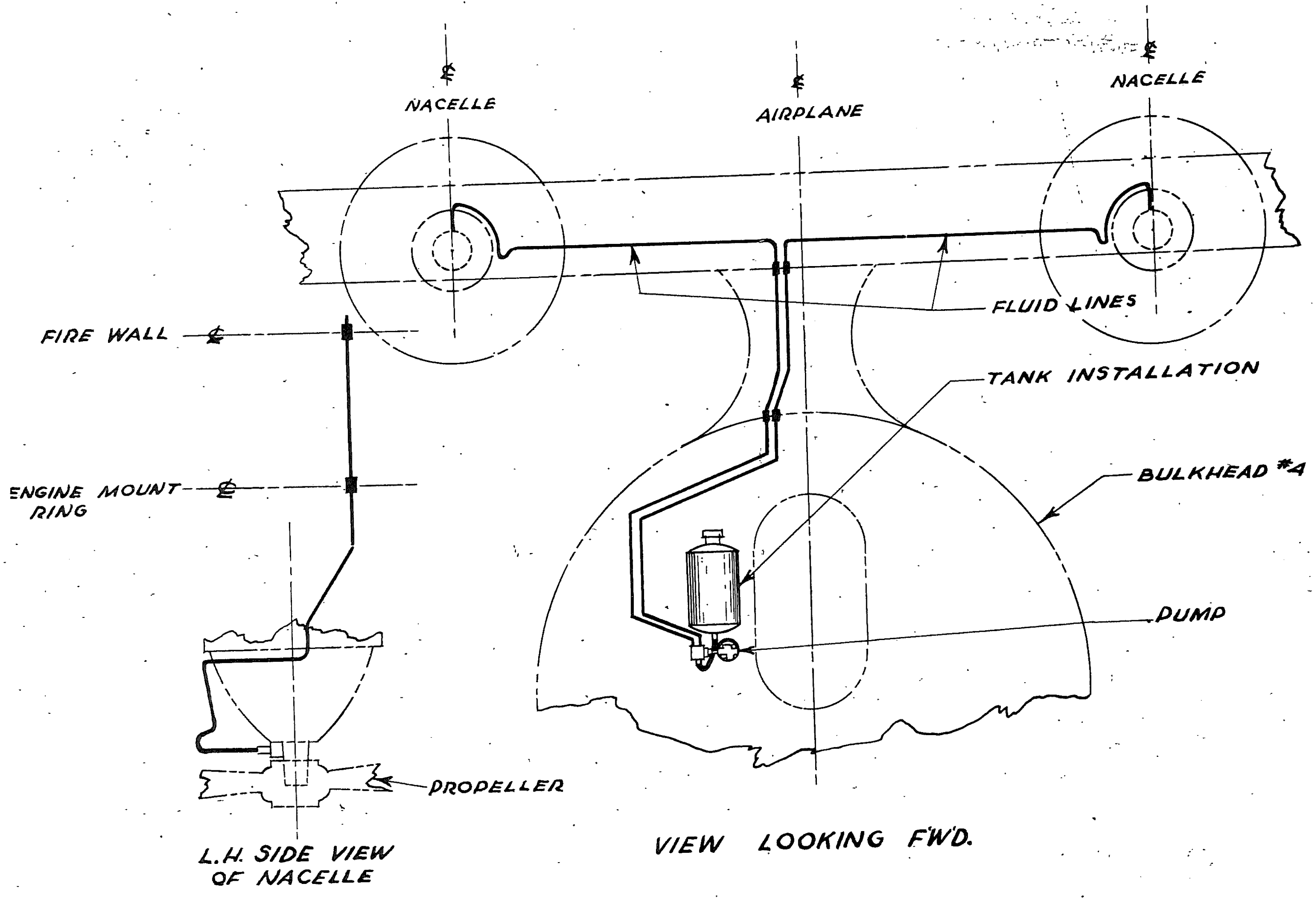
The engine crank for hand starting is located on the port side of the airplane just forward of bulkhead #5.

b. Electric Starting

The switches on the engineer's panel (Figure 49) are used to start the engines. This is done by pushing the center selector switch toward the engine to be started. Accelerate the starter by throwing side switch to "START" for 15 seconds. Throw same switch to "MESH" to engage the engine. For detailed starting instructions, refer to the check-off list in the pilot's handbook.



C28-049 FIGURE 29 12-4-40
CONSOLIDATED AIRCRAFT CORP
PROPELLER HOIST INSTALLED.



REFER TO C.A.C. DWG. 28P5060

FIGURE 30
PROPELLER ANTI-ICER SYSTEM

### c. Manual Starting

(1) To start the engines by hand, remove the starter crank handle from its stowed position on the forward face of bulkhead #5, in brackets, on the port side of the airplane.

(2) Standing on step just above wing leading edge, insert crank in bayonet slot of starter shaft.

(3) Turn over starter by turning the crank clockwise.

(4) See Pilot's Handbook for starting the engine.

### d. Installation (Ref. C.A.C. Dwgs. 28P5026 and 28P5109)

Installation of the electrical controls is automatically completed when the electrical system is hooked up.

Connect the manual release linkage to the starter. Install the starter crank universal and bracket.

The starter can be installed with the engine in place.

## 13. Engine Controls

### a. Description (Ref. C.A.C. Dwg. 28P5005; Figure 31 )

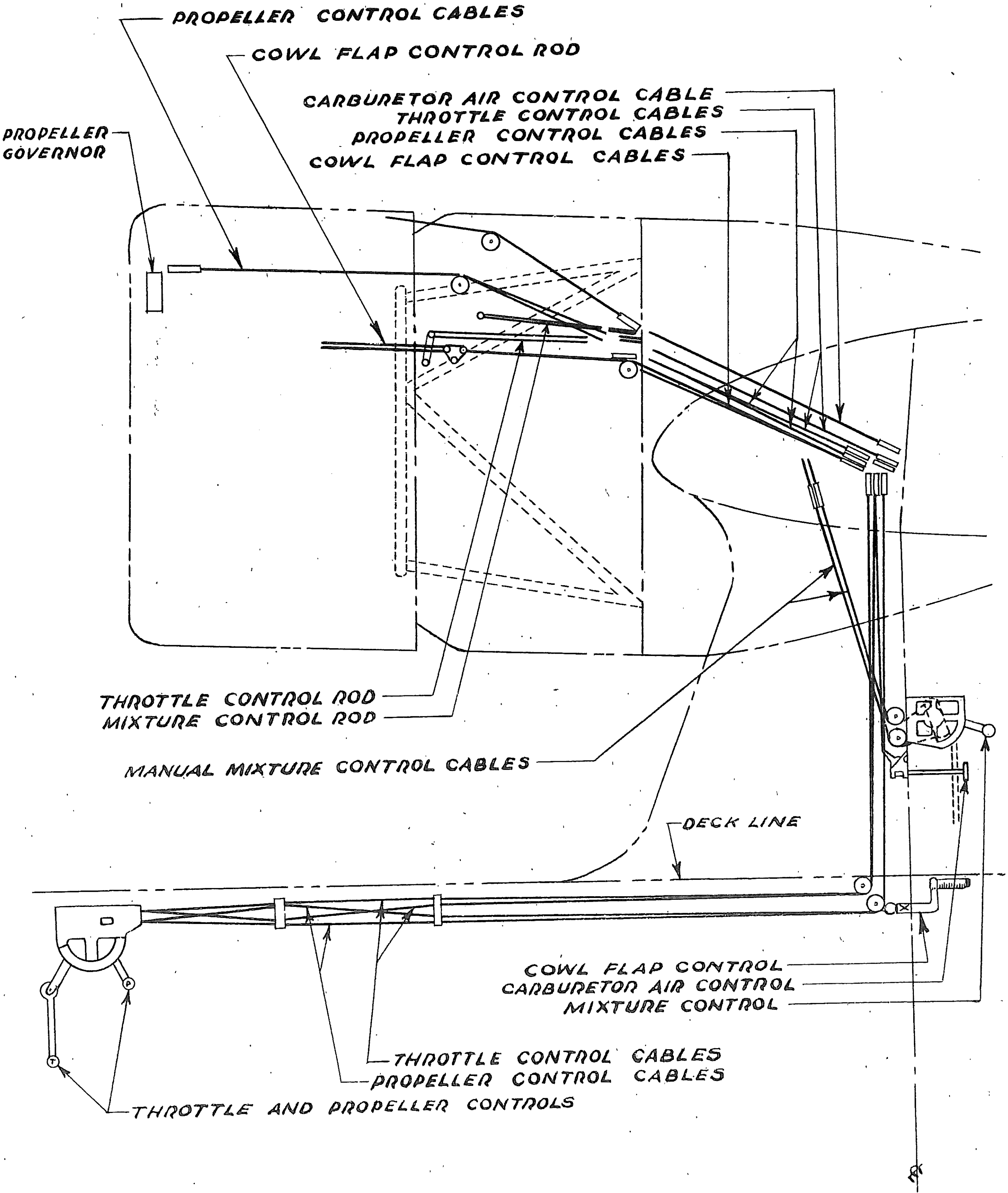
#### (1) Pilots'

The throttle and propeller controls run from a quadrant overhead of the pilots in the pilots' compartment. Cables run through suitable guides and pulleys back through the hull and up the superstructure into the wing. At this point they separate, running outboard to each nacelle where the carburetor controls connect to lever arms that operate rods attached to the carburetor. The propeller control cable carries through to the propeller governor. Both sets of controls are two-way cable systems. A diagram of engine control system is shown on Figure 31.

The ignition switches and master switches are on the control yoke between the pilots.

Propeller feathering switches are located overhead of the pilots just forward of the throttle control quadrant.

Throttle and propeller control identification bands are shown on Figure 32



REFER TO C.A.C. DWG. 28P5005

FIGURE 31

ENGINE CONTROLS DIAGRAM

(2) Engineer's (Ref. Figures 31 and 50)

The manual mixture, carburetor air and cowl flap controls are operable from the engineer's station. The manual mixture control is a two-cable system. The carburetor air control is a single cable spring return type.

The mixture control at the engineer's station is located just above the instrument panel. The handle positions are marked on the quadrant. The mixture control holds the fuel-air mixture ratio constant over changes in altitude and temperature in any position selected, except "FULL RICH".

The "IDLE CUT-OFF" position at the extreme lower end of the mixture control is used for stopping the engines.

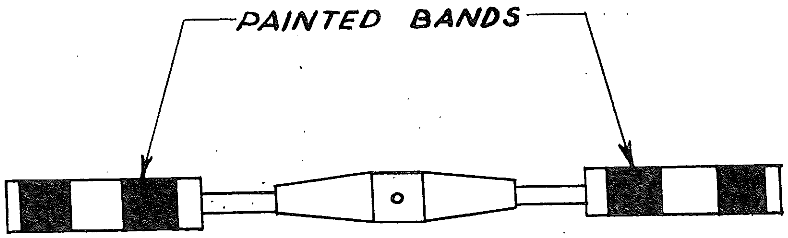
The carburetor air control knobs are on the engineer's instrument panel. The controls operate a valve on a protected air intake door in the carburetor air scoop.

Mixture, carburetor air and cowl flap control identification bands are shown on Figure

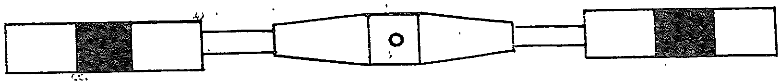
The cowl flap control is below the engineer's instrument panel on bulkhead #4. It is operated according to the instruction plate on the bulkhead.

b. Adjustment

Turnbuckles for adjusting the controls and to facilitate removal of the wing from the hull are located just forward of bulkhead #4. The forward cable sections will remain with the hull and the aft sections with the wing. After wing center sections and engines have been installed, connect cables from nacelle pulley brackets to the proper lever arms in the nacelles and connect rods to engine levers. Pass the cables at center pulley brackets down through hull superstructure and into the hull. Remove the clevis pin pulley guards from the pulley housing on the front face of bulkhead #4, and thread the cable through the pulleys as indicated on the diagram, Figure 31 . Cables are identified by painted bands on the turnbuckle terminals as shown on the cable identification diagram, Figure 32 . Connect these cables with those in the hull, making proper connections by matching paint bands.



FUEL MIXTURE CONTROL - TWO RED BANDS

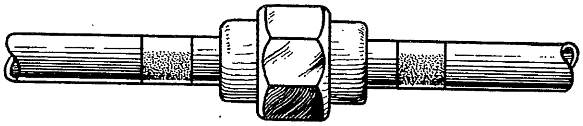


COWL FLAP - SINGLE BLUE BAND
THROTTLE - SINGLE GREEN BAND
PREHEATER - SINGLE WHITE BAND
PROPELLER CONTROLS - SINGLE BLACK BAND

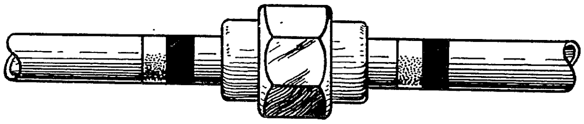
REFER TO C.A.C. DWG. 28P5005

FIGURE 32

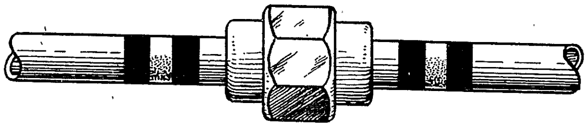
ENGINE CONTROL CABLE IDENTIFICATION CHART



FUEL = RED BAND
OIL (LUB.) = YELLOW BAND
FIRE EXTINGUISHER = BROWN BAND
AIRSPEED: PITOT PRESSURE = BLACK BAND
OXYGEN = LIGHT GREEN BAND



VACUUM = WHITE, LIGHT GREEN BAND
MANIFOLD PRESSURE = WHITE, LIGHT BLUE BAND
AIRSPEED: STATIC PRESSURE = LIGHT GREEN, BLACK BAND
VENT (CLOSED COMPARTMENTS) = RED, BLACK BAND
FLUID (ICE PREVENTATIVE) = WHITE, RED BAND



HYDRAULIC PRESSURE OIL = LIGHT BLUE, YELLOW, LIGHT BLUE BAND

NOTE:
SINGLE AND TWO COLOR TAPES ARE ½" WIDE, THREE COLOR TAPES ARE ¾" WIDE

FIGURE 33
PIPING IDENTIFICATION COLOR CODE

With control levers and levers on the engine in their mean adjustment positions, tighten turnbuckles as given in Section III-C. Make final adjustment so that control stops on engine make contact each way before control handle stops in quadrant are reached and check the system for freedom of action.

### c. Maintenance

Although the pulleys in the control system do not require lubrication, it is advisable to apply a small amount of oil or Rust Veto on the bearings occasionally as a rust preventive.

Light duty control pulleys are used extensively in the engine and propeller controls due to the light loads. These light duty pulleys may be replaced with AN standard pulleys if light duty pulleys are not available when replacements are required.

Control cables for this airplane are prestretched to 60% of their rated strength and should not stretch in service. However, any looseness that may develop should be taken out at the turnbuckles. Tighten both the direct and the return cable the same amount to avoid throwing the two-way cable systems out of adjustment.

### d. Disassembly

(1) When removing the wing, uncouple the turnbuckles in the hull.

(2) Remove the clevis pin guards from the pulley bracket on the bulkhead #4.0.

(3) Pull the cables through pulleys and up the superstructure. These cables will remain with the wing.

(4) When the engine mount is removed from the oil tank, detach the control rods from the bellcranks so that cables stay with the wing and firewall.

## 14. Engine Work Platform (Ref. C.A.C. Dwg. 28F5210, Figure 34 )

### a. Description

A work platform is provided for use when working on the engines or accessories. The platform is composed of two collapsible trussed frames which are suspended from hook sockets in the leading edge of the wing on either side of the nacelles, and a cross platform which is suspended from the two side units and latched in place. The cross platform forms the walkway in the rear gunner's compartment when not in use.

### b. Installation

To install the side platforms, walk out on the wing and place the hook hinge ends in the leading edge sockets on either

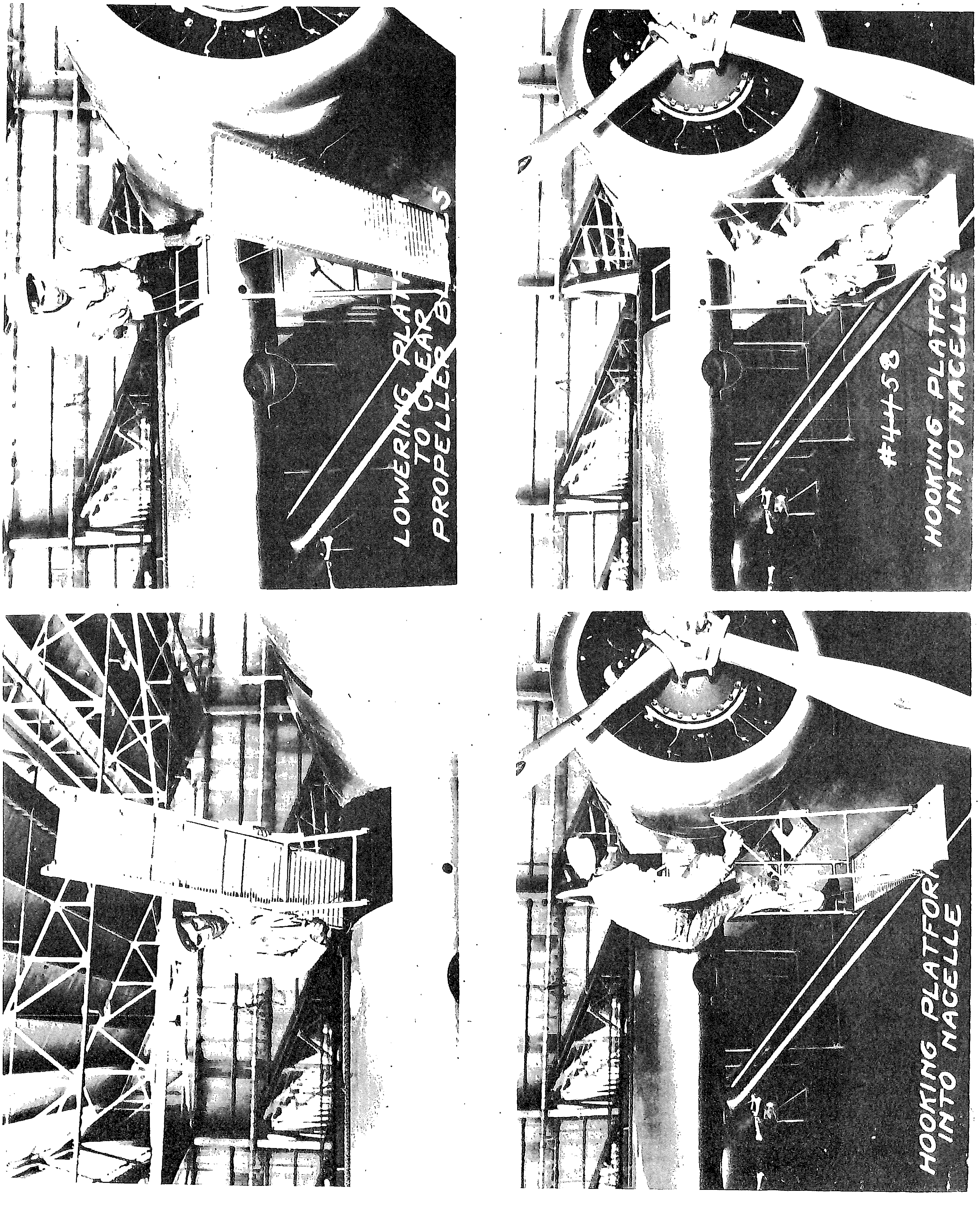

LOWERING PLAT
TO CLEAR
PROPELLER B S
#44-58
HOOKING PLATFOR
INTO NACELLE
HOOKING PLATFOR
INTO NACELLE

FIGURE 34

side of the engine nacelle. Lower the assembled trussed platform, folded, by hand to clear the propeller blades. By means of cable, lower walk section of platform to horizontal position. Climb down ladder and raise front section and hook onto nacelle as provided. See photographs on Figure . This procedure may be repeated for the platform on the other side of the nacelle. The cross platform may then be added if desired.

## 15. Pressure Fire Extinguisher (Ref. C.A.C. Dwg. 28F6011)

### a. Description (Ref. Figure 35)

### (1) General

A 9-1/2 $CO_2$ bottle with seat type valve is installed on a bracket located on the aft face of bulkhead #4.0 on the port side of the airplane. The valve is a short pull seat type valve.

A selector valve, for selecting either power plant, with a remote control release handle is located below the engineer's instrument panel.

A control line extends from the bottom of the selector valve to the control valve on the head of the $CO_2$ bottle. From there a $CO_2$ line is carried to each nacelle by way of the selector valve.

### (2) Nacelle Installation

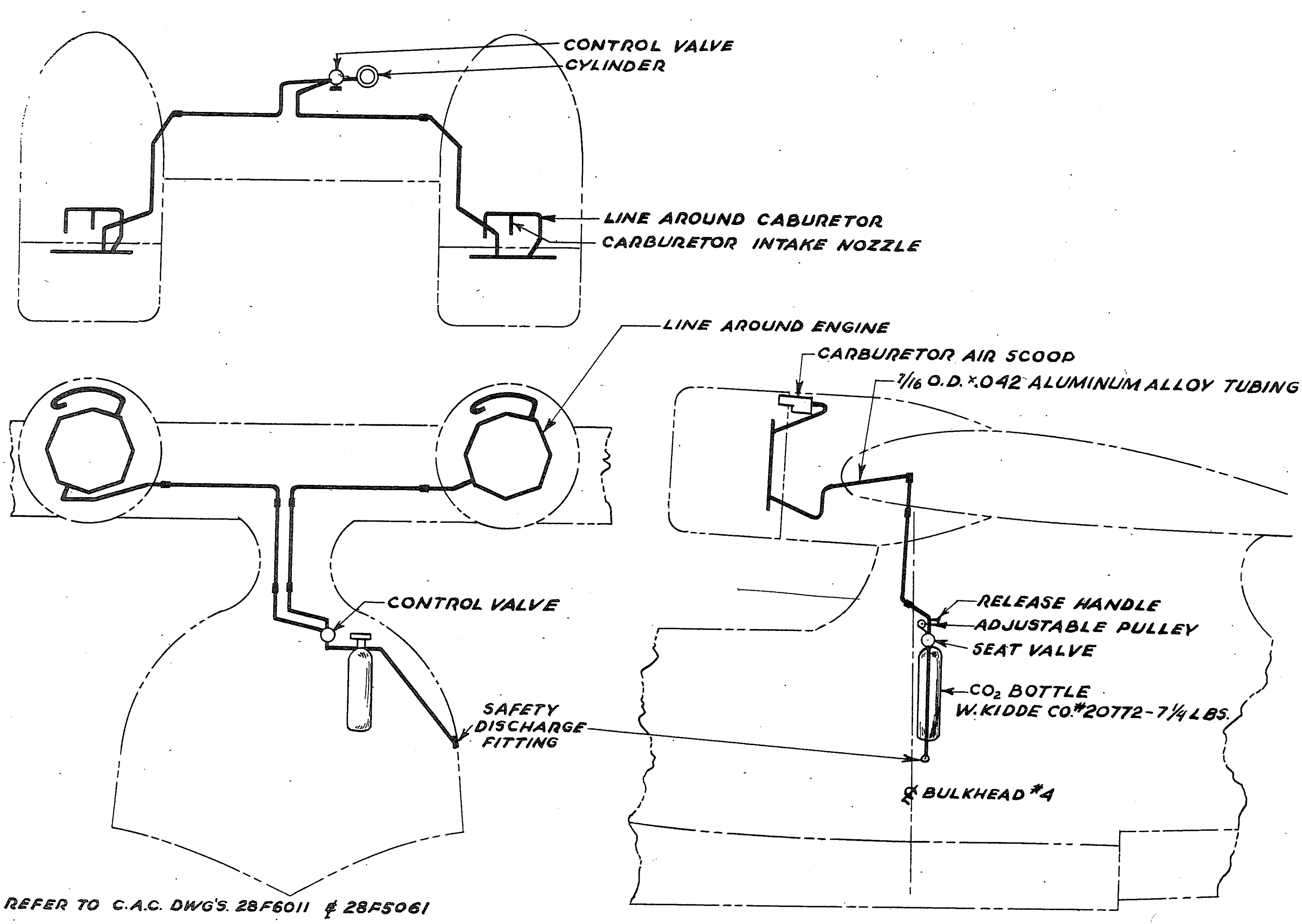
A perforated distributor line extends around the engine mount ring, as shown on Figure (Ref. C.A.C. Drawing 28F5061). From a tee in the upper part of this ring a perforated line encircles the carburetor. A flexible hose leads from this carburetor line to the carburetor nozzle in the air intake.

All piping is aluminum alloy tubing. Tube connections are made with aluminum alloy fittings.

### (3) Safety Discharge Fitting

A safety discharge line leads from the fire extinguisher bottle to a point under the port wing near the strut. This is a safety line used for discharging gas from the bottle in case the pressure exceeds the safety limit. At the end of the discharge line a red indicating disc is visible. When inspections are made, or when going into the airplane, this disc should be checked. If the red disc is intact, the bottle has not been prematurely discharged. If the red disc has been blown out the bottle has been discharged and must be replaced.

When there has been an intentional discharge of the bottle by pulling the discharge handle, a red disc is visible in the window of the discharge valve. The safety discharge signal does not function for intentional discharge.



REFER TO C.A.C. DWG'S. 28F6011 & 28F5061

FIGURE 35
NACELLE FIRE EXTINGUISHER SYSTEM

### b. Operation

Instructions for operating the extinguisher are given on the nameplate as follows: "To operate, set the valve on Port or Starboard engine, then pull release handle."

### c. Replacement of $CO_2$ Bottle

To replace bottle, remove cover of release lever chamber, remove screw in lever and loosen cable, being careful not to rotate lever more than 15°; follow directions in folder under the nameplate on the valve.

### d. Installation (Ref. C.A.C. Dwgs. 28F5061 and 28F6011)

(1) Wing is attached to the superstructure with the engines and accessories in place.

(2) Connect lines to fittings.

(3) Install lines to inboard of nacelles.

(4) Install lines to firewalls.

(5) Install lines to distributor ring.

(6) Install lines to carburetor.

### e. Disassembly

There are bulkhead fittings at the front spar for disconnection of the wing from the hull. Also there are disconnect fittings at the aft face of the engine mount.

All fire extinguisher lines are marked with a 1/2" band of brown paint near each union.

## C. Fuel System

### 1. Description (Ref. C.A.C. Dwg. 28G5011; Figure 38)

### a. General

The fuel system is a series feed type employing the use of engine-driven pumps. It consists of integral fuel tanks built into the wing center section with provisions for self-sealing fuel cells. Control cocks, strainers and wobble pumps are located in a compartment forward of the engineer's station with remote controls in the engineer's compartment. Flowmeters, dump valves and sight gages are also located in the engineer's compartment.

### b. Fuel Tanks and Self-Sealing Fuel Cells

The two fuel tanks are integral parts of the wing center section, located between the front and rear spar on each side of the airplane. They have a total capacity of 1750 gallons including the fuel sumps. Self-sealing fuel cells are installed on the port side of all even numbered airplanes and on the starboard side of all odd numbered airplanes under this contract. All airplanes have a vapor dilution system connected to the side opposite the self-sealing fuel cells.

The vapor dilution system consists of a carbon dioxide cylinder, aluminum alloy lines and fittings and a cable control running to the engineer's compartment. It is used in conjunction with integral fuel tank dumping.

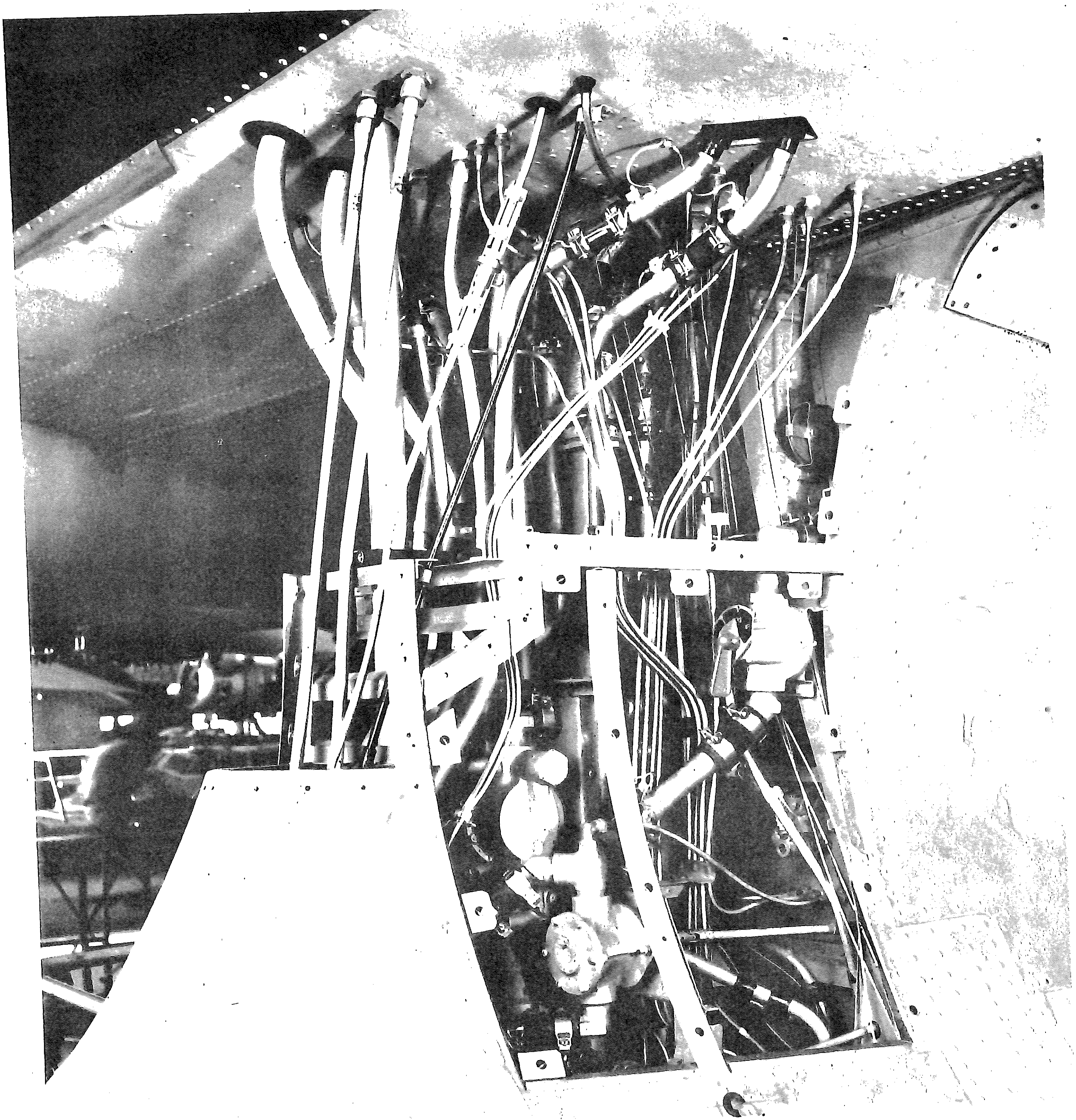
The fuel cell installation for each side consists of five interconnected cells, having a total capacity of approximately 620 gallons. Each integral tank has a manhole cover on the upper wing surface with two standpipe vents mounted thereon. The standpipe vent located outboard of the filler cap vents the area around the fuel cells; the standpipe vent inboard of the filler cap vents the cells themselves. In the absence of fuel cells, both standpipes in each manhole cover vent the integral tank. Access may be had to the integral tanks by removing the manhole cover; access to the fuel cells is through the upper access door on the upper wing surface and through the seven inspection doors on the lower wing surface.

The fuel sumps are located between the superstructure fairing and the engineer's compartment. Each sump contains a capsule of potassium dichromate crystals which help nullify the corrosive effect of any water in the gasoline. Each capsule is attached to a plug in the bottom of each sump.

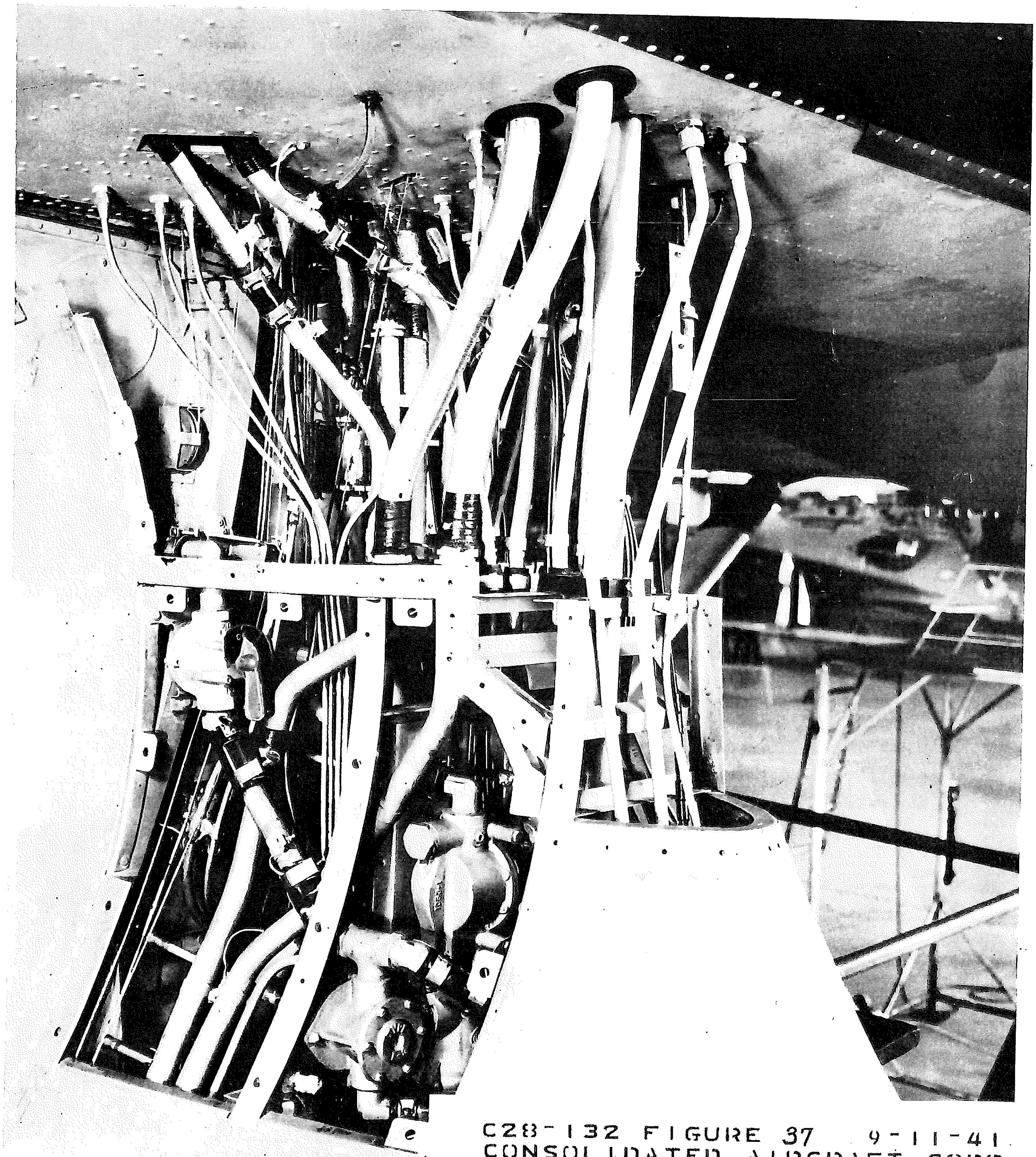
### c. Instruments

#### (1) Sight Gages

Sight gages are provided in the engineer's compartment at the fore and aft bulkhead. The gages are used to indicate the height of the fuel from full to half full and from half full to empty. Shut-off valves are incorporated in the gages to permit shut off of fuel from the gages in case of breakage. To correct these gages for the inclination of the airplane at various attitudes of flight, tilt charts are furnished in the engineer's compartment. Gage scales are calibrated to read the correct contents of the tank and/or cells when the airplane is at an angle of attack of 3-1/2° to the chord line. This is equivalent to a cruising speed of 105 knots. For the engineer's convenience, an inclinometer is mounted on the starboard side of the hull below the superstructure in the engineer's compartment. When the self-sealing fuel cells are installed, the left side of the sight gage scales will indicate the amount of fuel in the port side and is calibrated for the cell installation. Thus by reading the left side and right side scales and correcting the readings according to the tilt charts, the quantity of fuel in the cells may be determined.



C28-133 FIGURE 36 9-11-41
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A
FUEL UNITS INSTALLED IN
SUPERSTRUCTURE-PORT SIDE.



C28-132 FIGURE 37 9-11-41
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A
FUEL UNITS INSTALLED IN
SUPERSTRUCTURE-STARBOARD
SIDE.

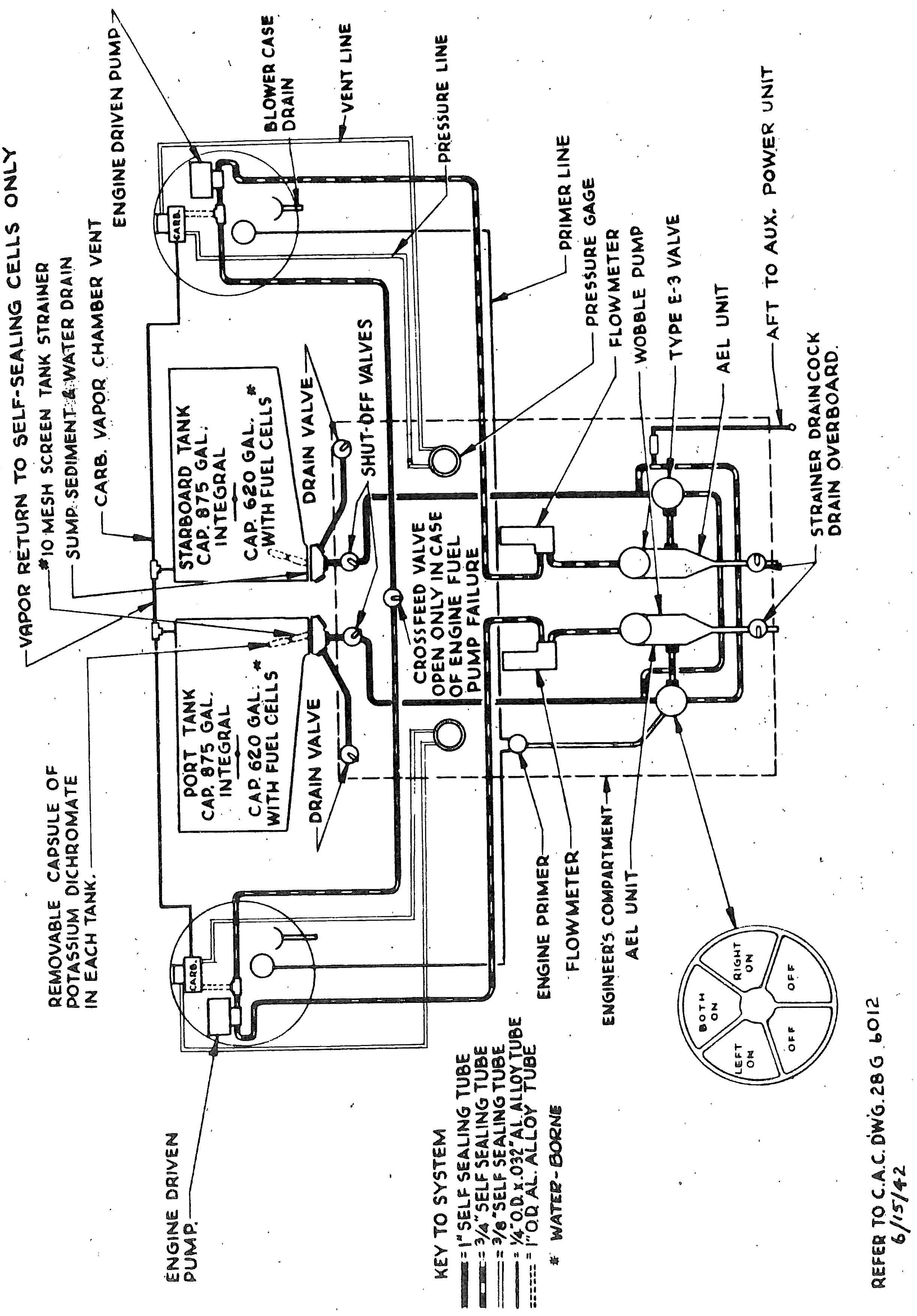

VAPOR RETURN TO SELF-SEALING CELLS ONLY
#10 MESH SCREEN TANK STRAINER
SUMP SEDIMENT & WATER DRAIN
CARB. VAPOR CHAMBER VENT
ENGINE DRIVEN PUMP
BLOWER CASE DRAIN
VENT LINE
PRESSURE LINE
PRIMER LINE
PRESSURE GAGE
FLOWMETER
WOBBLE PUMP
TYPE E-3 VALVE
AEL UNIT
AFT TO AUX. POWER UNIT
STRAINER DRAINCOCK DRAIN OVERBOARD
STARBOARD TANK CAP. 875 GAL. INTEGRAL — CAP. 620 GAL. WITH FUEL CELLS #
DRAIN VALVE
SHUT-OFF VALVES
CROSSFEED VALVE OPEN ONLY IN CASE OF ENGINE FUEL PUMP FAILURE
PORT TANK CAP. 875 GAL. INTEGRAL — CAP. 620 GAL. WITH FUEL CELLS #
DRAIN VALVE
REMOVABLE CAPSULE OF POTASSIUM DICHROMATE IN EACH TANK.
CARB.
CARB.
ENGINE PRIMER
FLOWMETER
ENGINEER'S COMPARTMENT
AEL UNIT
BOTH ON
RIGHT ON
OFF
OFF
LEFT ON
ENGINE DRIVEN PUMP.
KEY TO SYSTEM
= 1" SELF SEALING TUBE
= 3/4" SELF SEALING TUBE
= 3/8" SELF SEALING TUBE
= 1/4" O.D. x .032" AL. ALLOY TUBE
= 1" O.D. AL. ALLOY TUBE
# WATER-BORNE
REFER TO C.A.C. DWG. 28G 6012
6/15/42

FIGURE 38
FUEL SYSTEM DIAGRAM
(PBY-5, -5A)

Revised 4/1/42
C.A.C.

Examples of use: Ship is resting on water. Inclinometer reads 7°. Front fuel gage reads 500 gals. Rear fuel gage reads 600 gals. Referring to chart for front gage, the correct quantity of fuel in tank for a gage reading of 500 gals. with ship on water is 545 gallons. Referring to chart for rear gage, the correct amount of fuel for a gage reading of 600 gallons is also 545 gallons. The correct quantity of fuel in tank is, therefore, 545 gallons.

(2). Fuel Pressure Gage (Engine gage unit)

An engine gage unit giving the fuel pressure for each engine is located on the engineer's panel, Figure 49. Its range is from 0 - 25 pounds. The pressure indicated is that at the carburetor above the intake air pressure.

(3). Fuel Flow Meter

The fuel flowmeters are used to indicate the rate of consumption of fuel by the engines in gallons and in pounds per hour. They are located directly above the engineer's instrument panel.

The flowmeters are the float and tapered tube direct reading type with shut-off valves and integral bypass.

d. Connections (Ref. C.A.C. Drawing 28G3000, Figure 38)

There is a line running from the main starboard tank selector valve to the auxiliary power units selector valve. The power units are ordinarily connected to the main tank.

From the AEL Units lines go through the fuel flowmeters to the fuel pumps in each engine nacelle. There is a primer line connection at the main selector valve on the port tank which runs to the primer pump at the engineer's station, and a separate line to each engine. A vent line, runs from the carburetor vapor chamber to the fuel tank.

e. Fuel Units (Ref. C.A.C. Drawing 28G3000)

The fuel units are installed in the wing superstructure. The units include fuel flow meters, cross feed valves, fuel tank selector valves, strainer drains, and the fuel selector valve for the auxiliary power unit.

The front fairing, held by Dzus fasteners, is removable for access to the units and controls.

f. Fuel System Controls (Figure 49)

Selector valves and strainer drains, and the fuel cross-feed valves are controlled from the engineer's instrument panel.

The two control cocks with controls in the engineer's compartment are so assembled to permit fuel to be supplied to either or both engines from either or both tanks. The two C-2 strainers connected to the control cocks are drainable in flight, without disturbing flow of fuel to engine, by means of shut-off cocks in the engineer's compartment. Drain and refuel valves in the rear of the compartment are used for draining the entire system. There are connections to the outside of the superstructure to which a 1" pipe fitting can be hooked for pressure refueling.

The two hand wobble pumps and AEL Units, with controls in the engineer's compartment are provided for obtaining fuel pressure prior to starting. The wobble pumps have integral relief valves.

The dump valve is operated by a control handle located overhead and aft of the engineer's position. To purge the tank after fuel has been dumped, the vapor dilution system is operated by pulling the cable control handle located aft and overhead of the engineer's seat. Once the handle is pulled, the entire content of the CO2 cylinder is released into the empty fuel tank. The $CO_2$ purging bottle and piping system are located in the rear of the superstructure. (Ref. C.A.C. Dwg. 28G5054).

Parker valves will be replaced by Bendix or Schwien valves on all airplanes with serial numbers 04401 and on. Installation will be made by service personnel on airplanes with serial numbers 02948 to 02977 inclusive and 04399 and 04400. These valves prevent gasoline vapor from entering the fuel cells through the carburetor after the system has been purged.

## 2. Installation

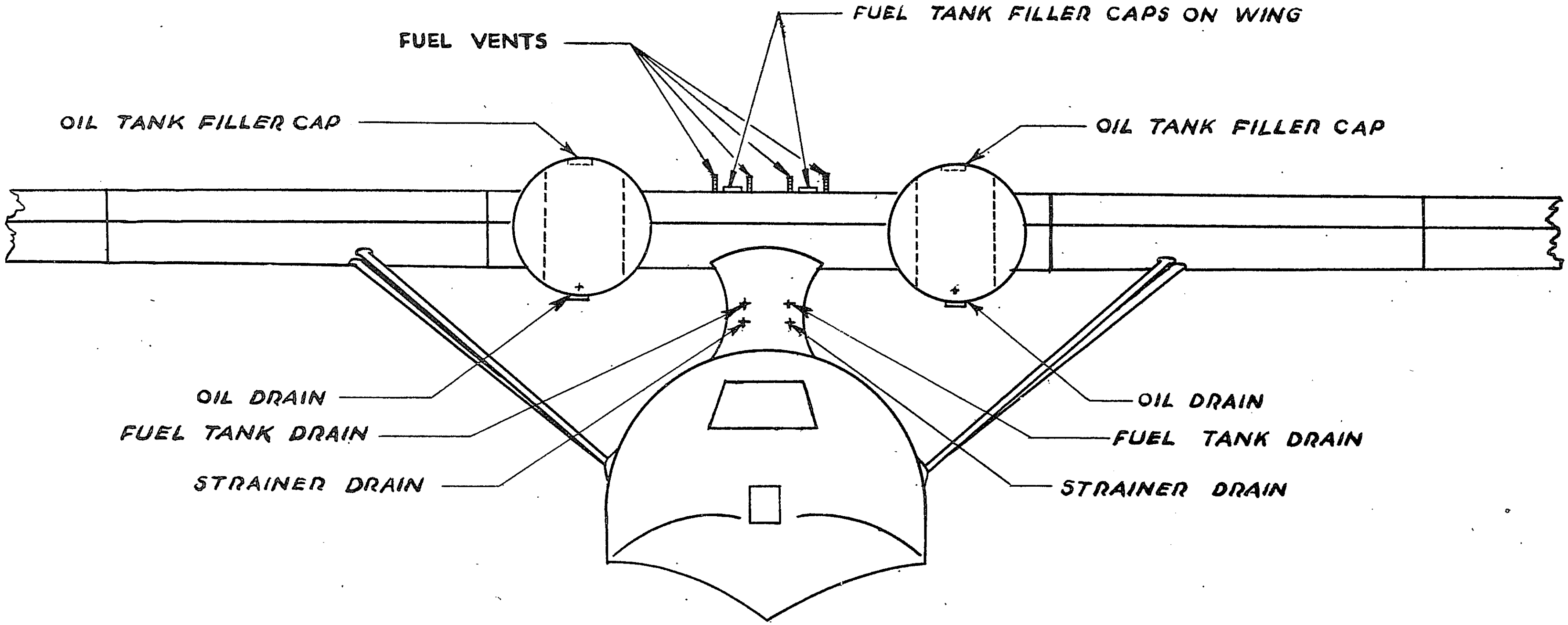
All aluminum alloy lines have a 1/2" red band painted near each end of each tube. The part number of each tube as given on 28G3000 is also painted near the end of each tube. For self-sealing fuel lines, refer to the fuel system diagram.

For assembly, make the necessary connections at the wing hull junction. Then install the necessary lines and make the connections to the nacelles.

## 3. Operation

Refer to the pilot's check-off list in the pilot's handbook for detailed starting procedure.

As soon as the engines are started the fuel is pumped into the carburetors by engine-driven pumps. The flow of fuel is from the tank sumps to the control valves. Here the fuel can be directed to either or both engines. From the control valves the fuel passes through the AEL Units, flowmeters and then on to the engine-driven pumps. After passing through the pumps, the necessary amount goes to the carburetors and all excess fuel returns via by-pass relief valves integral with engine pumps and from there back to the suction line to the pump. The cross-feed valve is to be used only when one engine pump fails.



REFER TO C.A.C. DWG. 28 G 3000 & 28-0-5002

FIGURE 39

FUEL AND OIL FILLER CAPS AND DRAINS

## 4. Fuel Tank Maintenance

### a. Inspection

Inspect main fuel tanks once between each interim overhaul at a period not to exceed one year, unless the tanks are equipped with a corrosion resistant system.

Inspect fuel tanks thoroughly whenever opened for repair or whenever there are indications of serious accumulations of water or sediment.

### b. Repair of Fuel Tanks

The fuel tanks are thoroughly tested by the manufacturer for leaks and will offer little trouble in service. However, in the course of time a leak might develop in the tank and the following is a brief resume of how to repair such leaks.

Practically all leaks that occur are due to rivets working loose. In most cases tightening the rivet with a rivet gun and bucking bar will eliminate the leak. However, if the rivet becomes cracked, while tightening it, it should be replaced. If the rivet happens to be a long one that goes through a fitting (3/4" or more) the rivet should be swelled in the hole before it is headed.

Any leaks along seams or handholes may be stopped by use of a special gun. This device can be improvised for an alemite type grease gun by arranging the nozzle end to accommodate a small tube (about 1/16" to 1/8" inner diameter). A mixture of powdered neoprene and bakelite varnish of the consistency of thick grease or glue is used in this gun. Neoprene may be powdered by rolling into a ball and grinding on a wheel. It will be noted that all crevices caused by gussets, reinforcement plates, etc., are plugged with a sliver of half hard aluminum. This plug is to be removed and the neoprene and varnish mixture forced into the hole. Running a wire into the hole first will help. If the tube on the gun is forced through a cube of sponge rubber, this rubber may be held tightly around the hole to be filled while forcing in the mixture and so help build up pressure.

If a leak develops between a reinforcing plate and the skin, a fine hole may be drilled into the space between and the special gun used to force the mixture between the plates. The hole must be plugged with a small rivet when the operation is completed.

If difficulty is encountered in locating just which rivet is leaking, the rivets may be tested by holding an air hose over each rivet in turn and putting soapy water over the other end of the rivet. This necessitates getting into the tank.

Before proceeding with the inspection of the tanks, the auxiliary power unit should be drained by disconnecting the flexible fuel hose at the unit.

### c. Fuel Tank Drain Valve

To maintain a tight seat in the fuel tank drain valve (6 to 10 pounds per square inch) operate it wide (not cracking) during early operation. This will permit any foreign matter to drain out, particles of which may have accumulated in the vicinity of the drain valve. This will reduce the necessity of servicing. Service consists of removing the valve from the airplane, cleaning the seat and plug of any foreign matter (zinc chromate paste, shellac, etc.) and reassembling.

## 5. Flushing Procedure

Before installing fuel and starting flushing operation, check that all outside electrical lines are disconnected and that the airplane is properly grounded. No work involving the use of electrically driven tools will be allowed in the airplane at this time.

Before putting fuel into the tanks, check that dichromate crystals are installed in the fuel sump finger strainers (both fuel cell and integral tank systems). Check that finger strainers are properly installed and safetied.

Put 73 octane fuel into left tank, and 100 octane fuel in right tank. (Integral tank systems). On airplanes having fuel cells installed, put 100 octane in tank having cells and 73 octane in other tank. Have all fuel valves in the "Off" position.

For airplanes having fuel cells installed in the right hand tank and tanks having no cells, flush the fuel system as follows:

Disconnect fuel line at tee on right hand engine and install drain hose to line. Put right hand selector valve on left tank (left valve is in "Off" position), and right flow meter by-pass in "On" position - pump enough fuel to flush this line with right hand wobble pump.

Then change right selector valve to "right tank" and put right hand flow meter by-pass in "Off" position and operate right hand wobble pump again, by so doing the flow meter is checked. (Line is also filled with 100 octane fuel). Then connect the right hand engine fuel line. Disconnect the crossover line on left engine at tee and install drain hose.

Put left selector valve on "left tank" (right selector valve in "Off" position) and left flow meter by-pass in "On" position. Pump enough fuel to flush line, using left hand wobble pump, then change left hand selector valve to "right tank" and left flow meter by-pass to "Off" position. Operate left hand wobble pump again, by so doing the flow meter is checked, (line is also filled with 100 octane fuel). Next put left selector valve in "Off" position and right hand selector valve on "right tank" and open cross-over valve; operate hand wobble pump to flush cross-over line, then connect cross-over line and close cross-over valve.

Flush the fuel system as follows:

Disconnect fuel line at tee on left hand engine and install drain hose on to line. Put left hand selector valve on right hand tank (right valve is in "Off" position) and left flow meter by-pass is in "On" position, pump enough fuel to flush this line with the use of the left hand wobble pump.

Then change left hand selector valve to "left hand tank" and put left hand flow meter by-pass in "Off" position, and operate left hand wobble pump again, by so doing flow meter is checked. (Line is also filled with 100 octane fuel). Then connect the left hand engine fuel line. Disconnect the crossover line on right hand engine at tee and install drain hose.

Put right hand selector valve on right tank (left valve is in "Off" position). Pump enough fuel to flush this line using right hand wobble pump, then change right hand selector valve to "left tank" and right hand flow meter by-pass to "Off" position. Operate right hand pump again, by so doing flow meter is checked. (Line is filled 100 octane fuel by this action). Next put right hand selector valve in "Off" position and left selector valve on "left tank" and open crossover valve; operate left hand wobble pump to flush crossover line then connect crossover line and close crossover valve.

Remove front plug from top of carburetors, and with mixture control in "automatic rich" position operate left hand and right hand wobble pumps respectively until fuel runs through plug hole in a clear stream. Immediately shift mixture control back to "idle cut off". In performing this operation have fuel selector valves on the tank containing the 100 octane fuel. This operation removes oil from the carburetor and clears the carburetor chambers of air.

Connect all lines and put right hand and left hand fuel selector valves on tank containing 100 octane fuel and pump up pressure to 15-18 pounds and check for leaks (right side with right hand pump and left side with left hand wobble pump). Then put left hand fuel selector valve in "Off" position, open crossover valve and right hand fuel selector valve on tank containing 100 octane fuel, pump pressure up to 15-18 pounds by using wobble pump.

Drain each A.E.L. strainer with its respective selector in all positions.

Flush auxiliary power unit fuel line by removing flex line at carburetor. Make certain that valve handle is in its proper relation to "Off" and "On" position marking.

On airplanes fitted with oil dilution systems check operation of oil dilution solenoid valve by breaking oil dilution line at valve and check that fuel flows from valve when valve is opened and when there is pressure on the fuel system. Also check that fuel ceases to flow when valve is closed, and that valve does not leak.

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C.A.C.

Note: This check must be made during flushing operation before engines are started.

## 6. Refueling Pump

A Romec refueling pump RG-4650 is stowed on the starboard side of the airplane between stations 5 and 5.25. It consists of a motor driven pump equipped with two lengths of gasoline resistant hose, one 25' long and one 10' long, and two Q5726-K1-18 straps for clamping the hose together outside of the airplane. The two hoses are stowed encircling the pump. (Ref. C.A.C. Dwg. 28F5380).

Complete operating instructions are provided with the refueling pump.

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C.A.C.

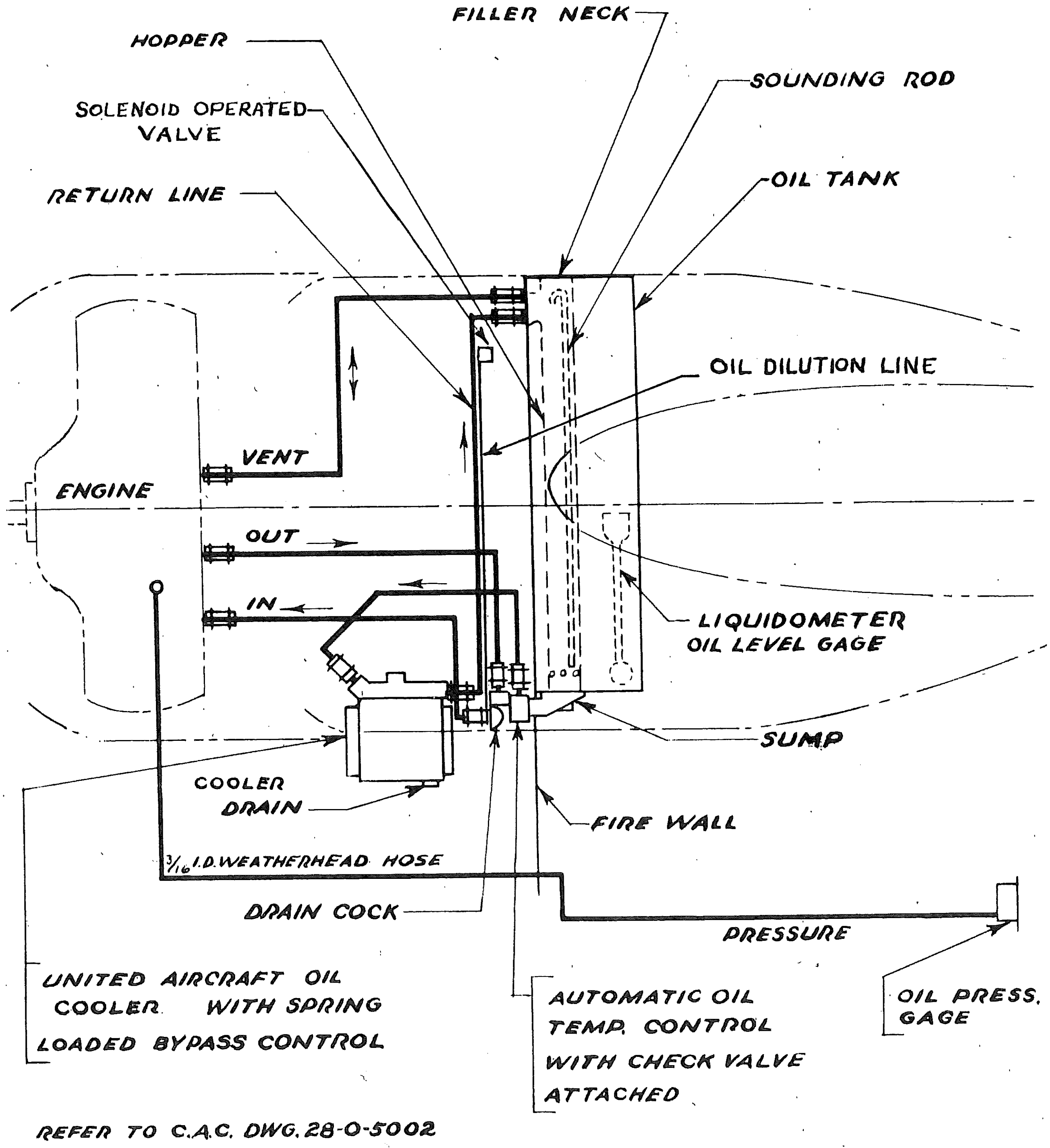

FILLER NECK
HOPPER
SOUNDING ROD
SOLENOID OPERATED VALVE
OIL TANK
RETURN LINE
OIL DILUTION LINE
VENT
ENGINE
OUT
IN
LIQUIDOMETER OIL LEVEL GAGE
SUMP
COOLER
DRAIN
FIRE WALL
3/16 I.D. WEATHERHEAD HOSE
DRAIN COCK
PRESSURE
UNITED AIRCRAFT OIL COOLER WITH SPRING LOADED BYPASS CONTROL
AUTOMATIC OIL TEMP. CONTROL WITH CHECK VALVE ATTACHED
OIL PRESS. GAGE
REFER TO C.A.C. DWG. 28-0-5002

FIGURE 40

Revised 4/1/42 OIL SYSTEM DIAGRAM
C.A.C.

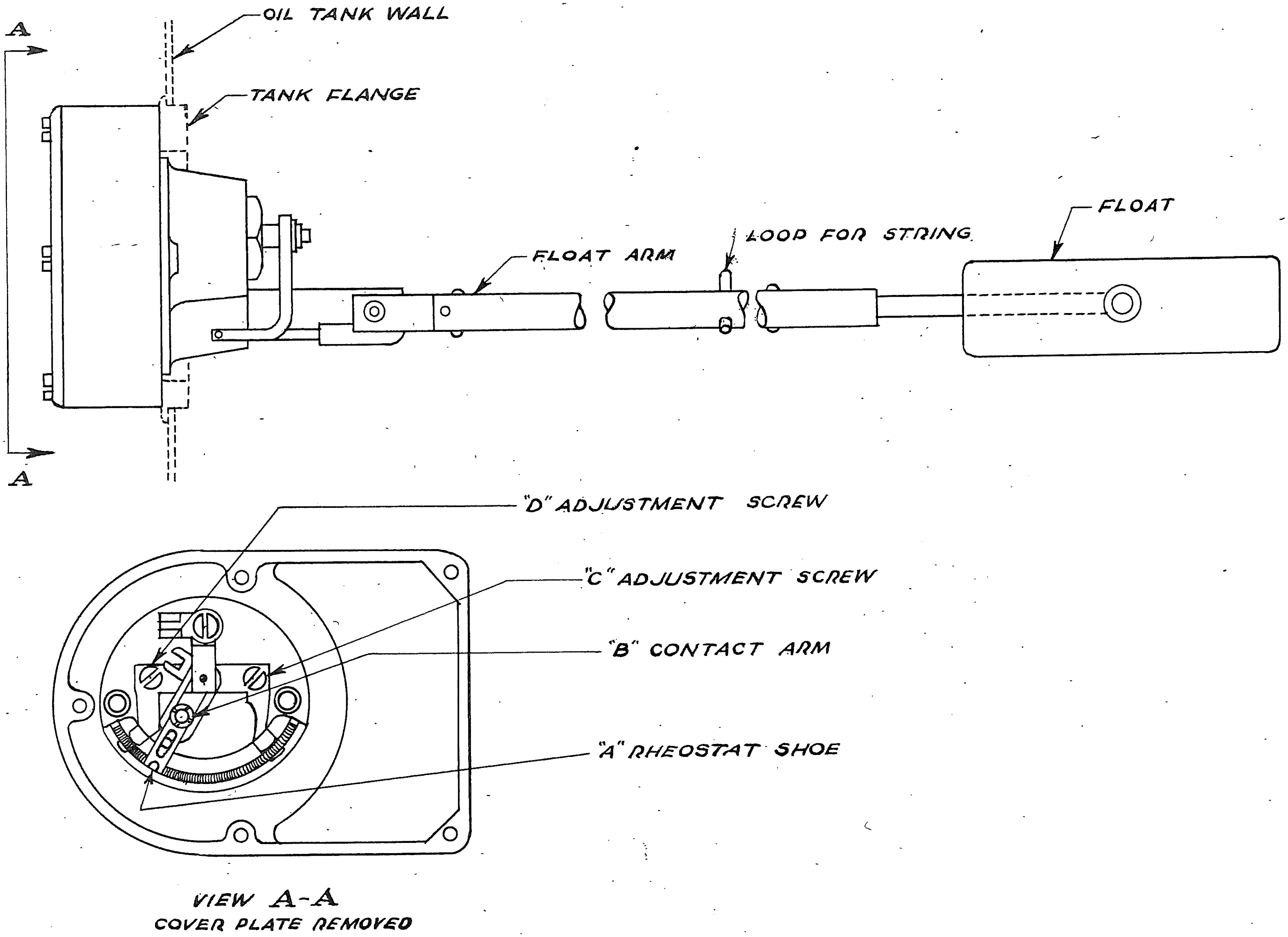


FIGURE 41
OIL TANK LIQUIDOMETER ADJUSTMENT

## D. Oil System

### 1. Description (Ref. C.A.C. Drawing 28-0-5000, Figure 40)

The oil system for each engine is made up of three major parts: Oil tank, oil cooler and automatic oil temperature control valve. 52-SO aluminum alloy tubing is used throughout the system with ells and nipples along with the standard hose and clamp type connections.

The oil tanks are an integral part of each nacelle and are monocoque structures. They attach to the wing and the engine mount attaches to the front face of the oil tank. The volume of each tank is 76 gallons total, or a maximum capacity of 65 gallons of oil and 11 gallons of foaming space. A liquidometer oil quantity gage is installed with remote reading indicator on the engineer's instrument panel.

There is a hopper for accelerated warm-up with a sounding rod in the forward side of the hopper.

A drain cock is located at the bottom of the tank forward of the sump as shown on Figure

### 2. Oil Cooler and Temperature Control Valve

The control valve, with integral check valve is located forward of the sump at the firewall. It is adjustable on the side for temperature range. This regulator by-passes all cool oil from the engine around the oil cooler directly into the bottom of the tank near the tank outlet to the engine.

The oil cooler is forward of the oil tank below the engine cowling. The air intake duct is just forward of the oil cooler.

The cooler is a 12" United Aircraft Model U3430-C, or equivalent, with an integral regulator drain and a spring loaded by-pass valve.

Each cooler is held in place by two padded ring braces which clamp around the circumference of the cooler, one at the front and one at the rear. The forward ring brace attaches to the engine shroud. The aft ring brace attaches to a former which in turn is clamped to the engine mount and a firewall support.

The main oil drain is mounted forward of the oil control and check valve at the firewall. There is a hex on the handle of the valve designed to take a 1" wrench if it sticks slightly. There is an oil drain plug in the bottom of the oil tank on the sump, and a drain plug in the bottom of the oil cooler and engine sump.

The oil quantity indicator is on the engineer's panel. It is an electric liquidometer type that indicates the amount of oil remaining in the tank for each engine. The float gage in the tank is also a liquidometer type.

An engine gage unit, giving the oil temperature and oil pressure for each engine, is located on the engineer's panel.

### 3. Operation (Ref. Figure 40)

When the engine is running, the oil circulates through the system beginning at the outlet in the bottom of the tank; from the tank through the automatic oil temperature control valve to the engine, and from the engine back to the automatic oil temperature regulator. If the oil "in" is hot, the oil "out" passes through oil cooler and then into the top of the oil tank. If the oil "in" is cool, the oil "out" is by-passed directly into the accelerating hopper in the tank.

### 4. Installation (Ref. Figure 33)

All oil piping is marked with a 1/2" yellow band and with part numbers corresponding to the numbers given on drawings 28-0-5000 at each end of each tube. Piping must be supported near connections and at intermediate points not more than 15" apart.

Install and connect all lines. The liquidometer gage is connected with the electrical lines.

### 5. Maintenance

The oil drain valve empties the entire system except the oil cooler, which has a separate oil drain plug. For best performance, it is well to clean the oil strainer in the engine at regular intervals.

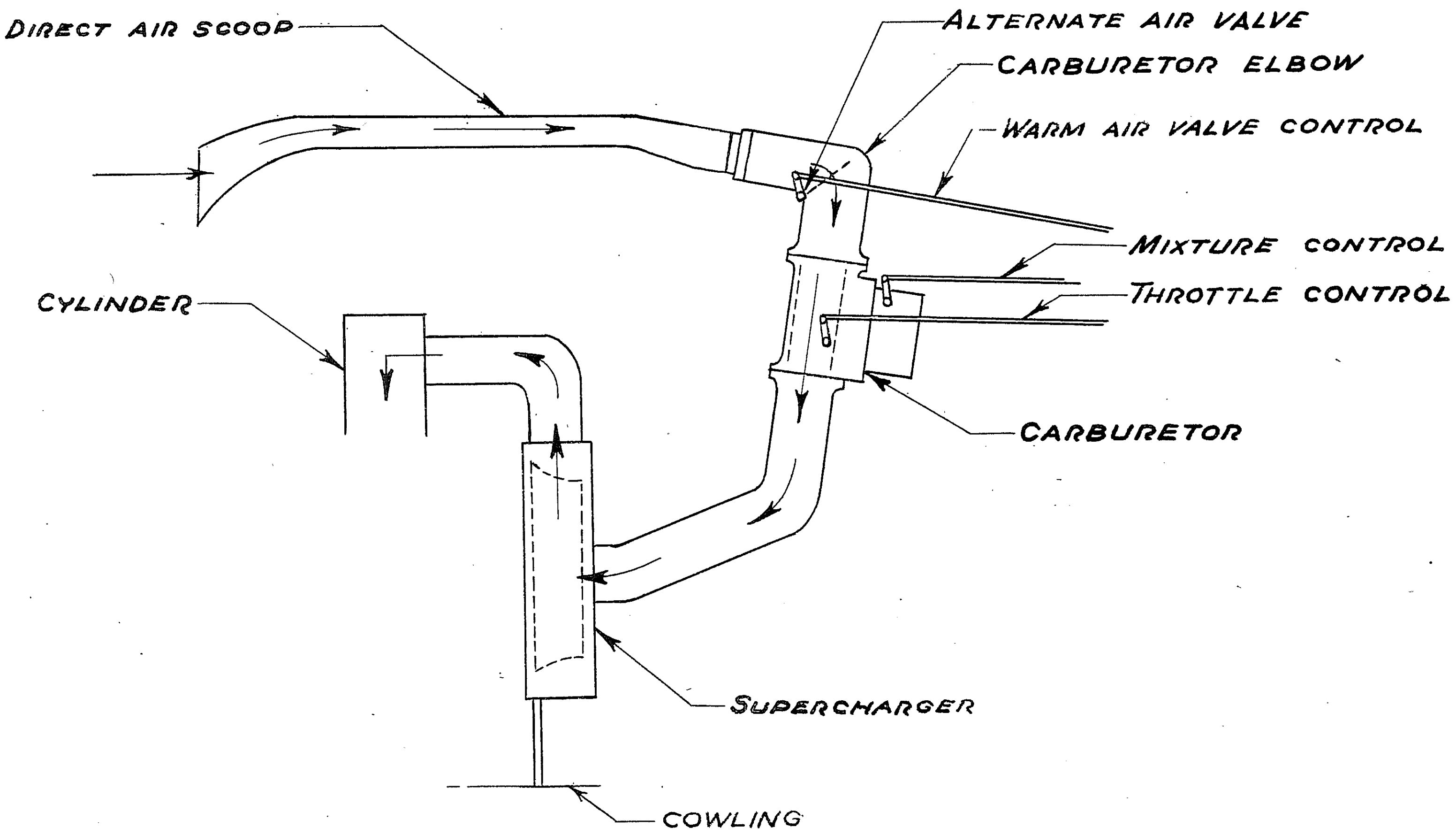
### 6. Oil Dilution System

To facilitate cold weather starting this airplane is equipped with an oil dilution system. Solenoid operated valves in the fuel line admit fuel into the oil system of each engine. The oil dilution solenoid switches are attached to the hull on the starboard side of the airplane just below the engineer's instrument panel.

## E. Engine Air Induction System (Ref. Figure 42)

### 1. Description

The "DIRECT" air scoop is located at the top of the engine nose ring cowl and provides a rammed air intake to the Bendix-Stromberg, pressure-injection, down draft carburetor. The "DIRECT" air intake is connected to the carburetor by means of the carburetor elbow. An "ALTERNATE" air valve in the elbow allows air to be taken from inside the engine cowl under icing conditions, rain, sleet or snow, when the carburetor screen is liable to clog with ice. This valve in the carburetor elbow is controlled from the Carburetor Air Control on the engineer's instrument panel as shown on Figure 49.



REFER TO C.A.C. DWG'S.
28P5008 & 28P5100

FIGURE 42
ENGINE AIR INDUCTION SYSTEM

The air is directed from the carburetor to the supercharger and from this point to the cylinders. The supercharger is a single stage, single speed type, geared 7.15:1.

### 2. Operation

For operation of the carburetor air control, refer to the Pilot's Handbook.

## F. Electrical System

### 1. Diagrams

The following diagrams supplied with the airplane, will be found in a container below the distribution panel in the radio compartment.

28E5675 - Wiring Diagram
28E5656 - Conduit Assembly Diagram
28E5042 - Interphone Wiring Diagram

### 2. Description

The main power supply is furnished by a 24 V.D.C. System. An A.C. System is available for the radios. Current is supplied by two S-34 storage batteries in the leading edge of the wing center section which can be connected to the 24 volt, D.C. generator in each engine, through the distribution panel. Two S-17 storage batteries in the radio compartment are connected in series to supply current for the radio and communications system. The batteries may be charged from either of the two engine generators or the auxiliary power plant generator.

The main controls for the electrical system are on the main distribution panel on the forward face starboard side of bulkhead #4.0.

### 3. Batteries

The two type S-34 storage batteries, with integral containers are located in the leading edge of the wing center section inboard of each nacelle. They are series connected to develop 24 volts. Connections are such that a battery may be charged independently of any other battery and with any generator, by proper selection of buses on the distribution panel. These are marked on the face of the panel. All equipment, the circuits of which originate at this point, may be switched from either bus on any combination of batteries or generators desired, as the circuits are connected to the center taps of the switches.

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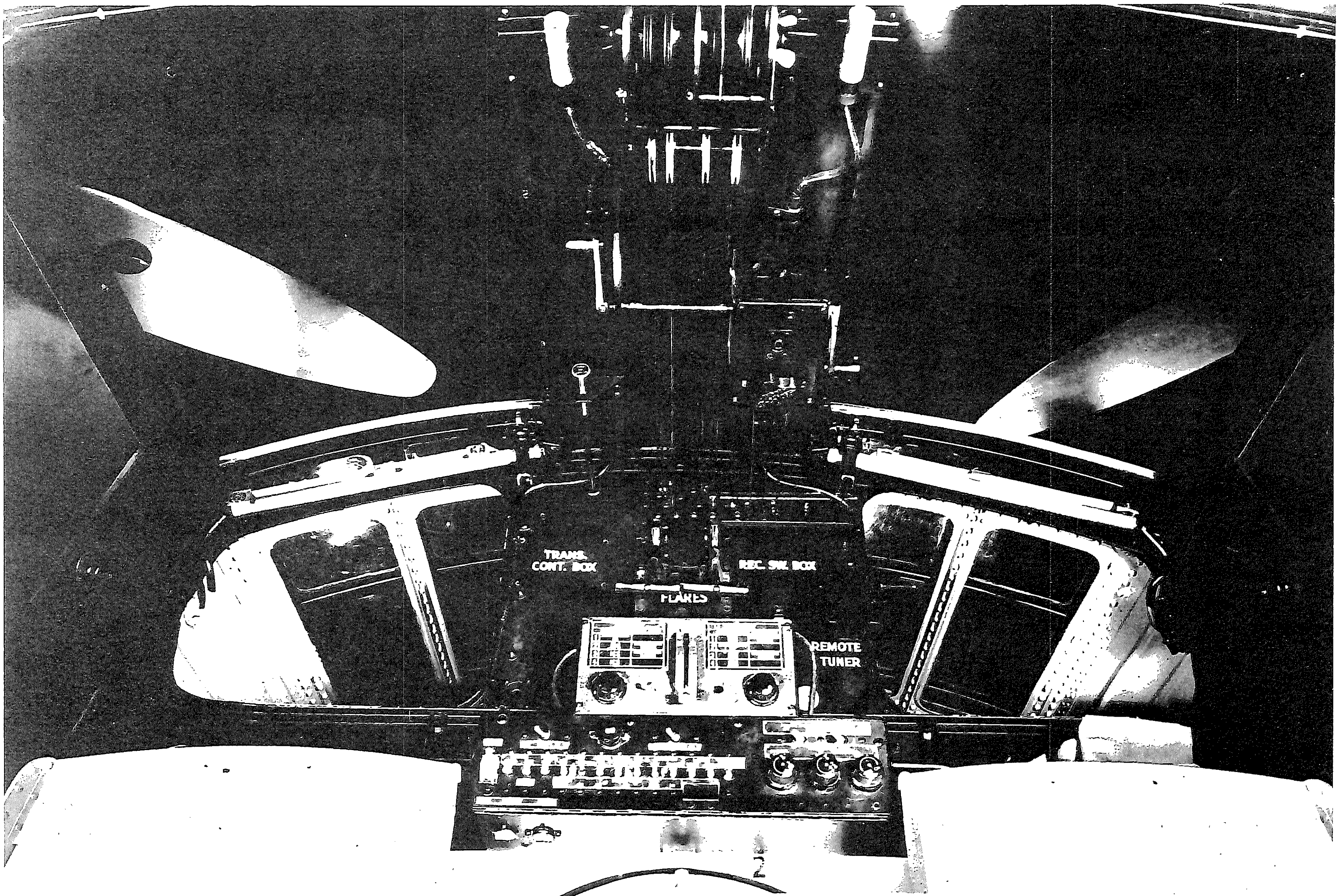
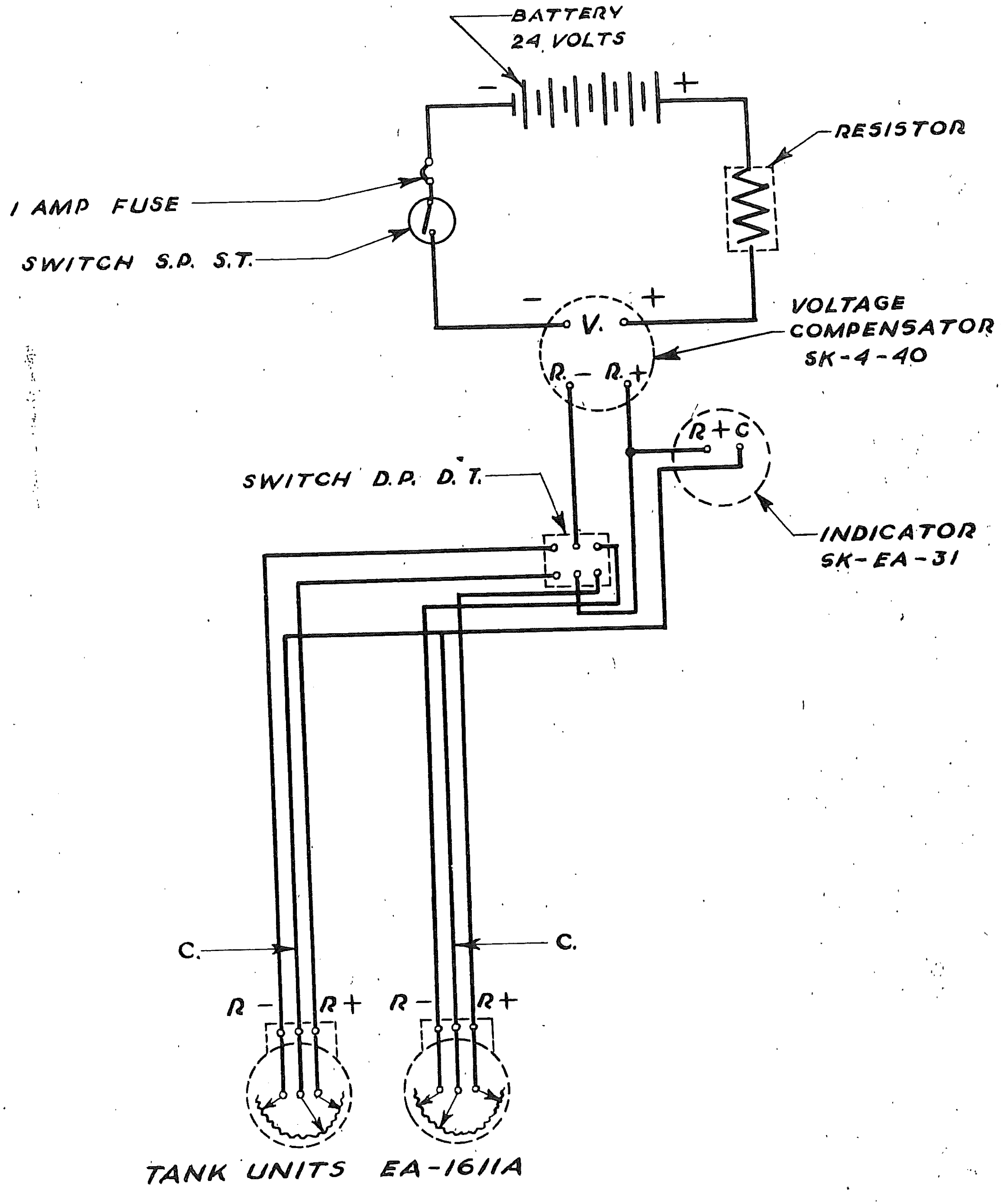
(Bureau of Aeronautics)



C28-152 FIGURE 43 10-21-41
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A
PILOT'S ELECTRICAL
CONTROLS ON BULKHEAD NO. 2



REFER TO C.A.C. DWG. 28 E 5675

FIGURE 44
OIL TANK LIQUIDOMETER WIRING DIAGRAM

Two type S-17 storage batteries with integral containers are located in the radio compartment underneath the radio operator's chair. These batteries are connected in series to develop 24 volts.

These batteries are connected through a reverse current relay to a switch on the distribution panel, and through an ammeter. It is intended that these batteries be used for radio equipment only.

The batteries may be charged in the conventional manner from any of the generators. The reverse current relay will prevent a discharge of the radio battery back into the airplane electrical system. This relay will open when a reverse current of not more than five amperes is drawn through it. Therefore, after the radio battery has been on charge, it will be necessary to throw this battery on either "A" or "B" bus and turn on navigator's table lights at full brilliance or two compartment lights on the same bus to draw the required current.

Alternating current radio power is provided by the left hand generator. Generator leads for this purpose terminate at double pole double throw-selector switch located alongside the distribution panel. AC terminals are provided at the rear of the main radio transmitter, with DC terminals, for radio power supply. DC terminals alone are provided also on forward face of bulkhead #4 near main receivers, and on aft face of bulkhead #3 under the model GF equipment.

A 24-volt, D.C. Generator is installed in each engine. An NEB-1D generator which delivers AC and DC current is mounted on the auxiliary power unit and is furnished with an NF-1D control box. NOTE: When possible, start the auxiliary power plant for electric starting of the main engines in order to save the batteries.

Batteries may be charged in the conventional manner from the generators by means of the control switches on the main power panel at bulkhead #4.

### 4. Equipment

#### a. Main Engine Starting System

Starters may be electrically energized from the engineer's instrument board in the hull superstructure by means of three toggle switches in standard arrangement.

#### b. Ignition System

The ignition system, a dual magneto type, is controlled by a switch on the control yoke in the pilot's compartment only.

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### c. Floats

The float control switch is located on the port side of the engineer's seat. Position lights on the engineer's and pilot's panel indicate the "UP" position of the floats when the throttles are closed. A micro switch, located approximately six inches inboard on the port wing, controls the float down limit by cutting off the relay and turns off the float warning light. Another micro switch, located inboard of the lead screw, cuts off the relay controlling the limit of up travel.

In case of failure of the micro switches, check for loose wiring. If the switch is damaged or broken, replace with a new switch. The description, operation and the maintenance of the float retracting electrical equipment is given in Part I of this Section.

### d. Interior Lighting and Outlet Receptacles

Interior lights and receptacles are furnished through out the airplane hull compartments as far aft as the rearmost gunner's station. Switches are located on instrument panels or in junction boxes in nearest conduit line. Pilot's instrument panel lamps are fitted with a rheostat for control of illumination intensity. The pilot has a switch on his panel for the projection light. Spare lamp bulbs are located in a container near distribution panel.

Panel light, table, and projection light rheostats are provided on the main distribution panel for control of illumination intensity.

The engineer's compartment light switch is on the engineer's panel. The compartment light switch for the living quarters is on the forward side of bulkhead #6. The gunner's compartment light switch and light are on the aft side of bulkhead #6. The tail gun compartment light is on the aft side of bulkhead #7.

### e. Exterior Lights

Exterior lights include landing lights, running lights, tail light, section light, formation lights, anchor lights, signal lights and recognition lights. The main power switches and fuses for these lights are on the main distribution panel. A spare fuse box is located in the main distribution panel. Individual switches, with the exception of recognition light switches, are mounted on the pilot's electrical control panel located on the forward face of bulkhead #2. Refer to Figure

Two landing lights are located on the leading edge of the wing center panel, on each side of the center line. The "UP - DOWN" switch on the pilot's electrical panel controls and operates the relays, located in the engine terminal boxes, which supply current directly from the battery to the lamps. Lamp power circuits are provided with protective fuses in the engine terminal boxes. Adjustments to the lights can be made on the ground only and require removal of two cottered nuts and cover glass. These lights facilitate take-off and landing at night.

Two running lights are located on the forward side of the wing tip just inboard of the wing tip float. A "BRIGHT - DIM" switch is mounted on the pilot's electrical panel. The port light is red and the starboard green.

A white tail light located on the rudder is controlled by a "DIM - BRIGHT" switch mounted on the pilot's electrical panel. For night flying the running lights and tail light outline the limits of the airplane.

The section light is located just aft of the side gun blisters on the top side and center of the hull. It is a lunar white light, the intensity of which is limited to intra-squadron calling and is controlled by an "ON - FLASH" switch mounted on the pilot's electrical panel.

Formation lights are located on the upper surface of the wing trailing edge 23" inboard of the floats. The lights are used in formation flights. An "ON" "FLASH" and "BRIGHT" "DIM" switch controlling the lights are located on the pilot's electrical panel.

Two anchor lights located on the upper side of the wing tip floats at each end of the wing provide light for small boats approaching the airplane. It is controlled by an "OFF - ON" switch mounted on the pilot's electrical panel. Another switch controlling these lights from the outside of the airplane is mounted on the portside of the hull at station "1.66 approximately 15" below the pilot's windshield.

The signal light shields are located just aft of the side gun blisters on the top side of the hull approximately 18" on each side of the section light. The bomber's salvo signal lights (photo flash) are mounted within the shields.

Four recognition lights are provided. Three lights are located six inches inb'd. of the starboard retractable wing tip float on the under surface. From the wing tip inboard they are red, green and amber. The fourth is a white light located on the upper surface of the wing just inboard of the wing tip float. The controls are located in the center of the pilot's yoke on the underneath side.

### f. Cooking

A Z-unit electric hot plate for cooking purposes is located in the engineer's compartment.

### g. Tachometers

Electric engine tachometers, as supplied on the airplane, require no outside source of power. The wires for the circuits are in the same conduit as the light and power circuits and are disconnected at the same places and in the same manner. Tachometer generators are located one on each engine and indicators are located in pilot's instrument and engineer's instrument panels.

A synchronizer unit is located on the pilot's instrument panel between the two tachometers, and is operated from the tachometers to aid the pilot in synchronizing the engine speed.

### h. Bombsight

Bombsight power is controlled by a switch on the main distribution panel, with a separate switch for the pilot director indicator. The bombsight connection is made by a plug permanently installed adjacent to the sight bracket. Refer to Section VI, Part C, for details.

### i. Bomb Release

Electric bomb release control circuits are operated by a group of switches on the bomber's instrument panel. Release may be accomplished automatically through the bombsight or manually by means of the firing control switches. A receptacle is provided, adjacent to the control switches, for the firing switch. The bomb control circuits operate relays located in the engine terminal boxes. Through the main contacts of these relays, current is supplied to the bomb rack solenoids. The bomb release and firing key receptacle are installed on the pilot's switch panel. Refer to Section V, Part C, for details.

### j. Torpedo Release

Electric torpedo release circuits are operated by switches on the pilot's switch panel. Release is accomplished by inserting a firing key into the receptacle on the switch panel. Circuits operate relays which connect the torpedo rack solenoids directly to the battery circuits. The relays are located on the front spar, near the bomb racks. There are no torpedo release switches provided for the bomber.

### k. Fast Feathering Switches

Fast feathering control switches are located on the pilot's ceiling forward of the throttle control quadrant.

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## 1. Ulta-Violet Illumination of Instruments

### (1) General

The lamp assembly, type X-220, is designed for the illumination of the instruments and has no visable light output. The assembly consists essentially of a metal lamp housing a replaceable lamp cartridge, and a connector. The lamp cartridge combines the fluorescent lamp (4 watt), lamp starting switch, ultra-violet filter and variable intensity control. Three intensities of ultra-violet output are available by rotating the end cap of the lamp housing to the three stop positions.

### (2) Power Supply

Fluorescent lamp must be operated from a 110 volt power supply with the necessary lamp reactor and starting switch. An inverter is used to provide 110 volt power for operation of the lamps.

### (3) Inspection and Maintenance

#### 250 Hour Check

Check operation of lamp assembly and lighting system. Lamp cartridges should be replaced after 500 hours of use.

## m. Inverter

### (1) Description

The type S-666 Inverter is of the vibrator type and designed to operate on 25 volts DC, plus or minus 2-1/2 volts. The inverter is designed to convert the DC voltage to AC voltage capable of operating four 4 watt fluorescent lamps.

The vibrator element of the inverter, which is operated by an energizing coil, produces pulsating direct current which in turn is transformed to 110 volts alternating current by the leakage reactance type transformer. The transformance serves both as a step-up transformer and a lamp reactor. A capacitor is used across the primary of the transformer to correct the power factor of the circuit to approximate unity. The inverter is supplied with audio and radio frequency filter circuits to eliminate radio interference.

The connector marked "3V" is the output from the 3 volt AC for the operation of 3 volt instrument and signal lamps. The 3 volt output is obtained from a separate and isolated shielded coil on the transformer. The connector marked "DC" is for the 25 volts input supply. The negative side of the input circuit and one side of the lamp circuits are grounded. The connectors marked "1", "2", "3", and "4", are the outputs for the fluorescent lamps. The inverters should be operated with four lamps; if it is desired to use fewer lamps, it is necessary to use a dummy load on the other lamp outlets. This can be accomplished by the use of an adaptor assembly, Electronic S-751, which is screwed on the lamp outlet not in use.

(2) Installation of the Inverter

Installation of the inverter is accomplished by fastening the four mounting lugs to their respective supports. These lugs must be electrically bonded to the airplane frame, removing any paint or oxides which may be present. Make sure that the inverter is securely bolted in place.

(3) Operation

The inverter is operated by a control switch in the primary circuit as shown in figure 78F. This switch is located on the pilot's switch panel and works in conjunction with the projector light switch.

(4) Inspection

At 250 hour periods (time of operating the lighting system) -

(a) Check inverter for outputs and satisfactory operation.

(b) Check vibrator to be sure it is tight in the socket.

(c) Check fuses.

(d) Check all soldered joints and leads.

(5) Maintenance

Replace the vibrator at 500 hours of operating time of the inverter.

(6) Equipment Troubles and Service Repairs

| TROUBLE | PROBABLE CAUSE | REMEDY |
|---|---|---|
| No 3 volt power | 1. Vibrator not clamped in socket | 1. Replace vibrator firmly in socket |
| | 2. Defective vibrator | 2. Replace with new vibrator |
| | 3. Poor connections | 3. Make sure all connections are clean and tight |
| | 4. Improper connections | 4. See circuit Fig. |
| | 5. Fuses Blown | 5. Replace fuses |

When one fluorescent lamp is inoperative, the 3 volt circuit may also be inoperative.

| TROUBLE | PROBABLE CAUSE | REMEDY |
|---|---|---|
| No fluorescent lamp operating | 1. Fuses blown | 1. Replace fuses |
| | 2. Loose or high resistant connections | 2. Clean and tighten all connections |
| | 3. Vibrator not clamped in socket | 3. Replace vibrator firmly in socket |
| | 4. Defective vibrator | 4. Replace with new vibrator |
| | 5. Improper connections | 5. See circuit Fig. |
| No operation of circuit or lamp | 1. Fuse blown | 1. Replace fuse |
| | 2. Improper connections | 2. See circuit Fig. |
| | 3. No battery voltage | 3. Check battery supply and ground |

(7) Disassembly

Remove the flat head machine screws on sides of the inverter cover. Panel and subassembly may then be pulled directly out of the case. All cables should be removed from the inverter before the case is removed.

(8) Inspection

(a) Inspection should be made as follows:

1. Clean and tighten all connections.
2. Make sure vibrator is tight in socket.
3. Check all soldered joints and leads.
4. If vibrator fails, replace with new one.
5. Check battery supply and ground.

(b) If inverter fails to operate after the above check, a test may be made by the following procedure: The following meters will be necessary for the test; a DC voltmeter, 0 to 30 volts; an AC voltmeter, 0 to 5 volts; a DC ammeter, 0 to 5 amperes; and an AC milliameter, 0 to 200 milliamperes. The DC meters are used on the 3 volt circuit. With reference to the circuit diagram Fig. 78F, a point to point check may be made. The readings should approximate those on the following table.

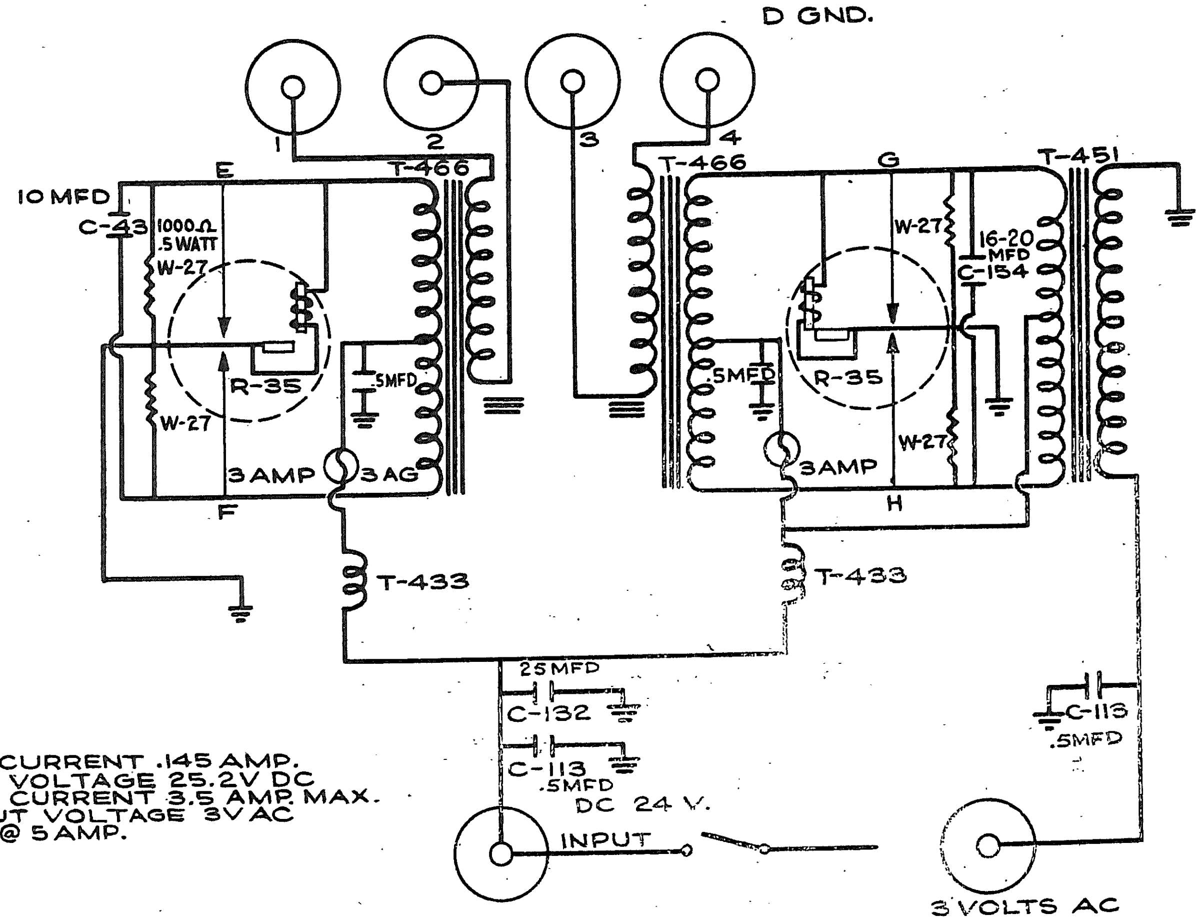
| | Voltage Lamp On | Voltage Lamp Off | Voltage | Resistance |
|---|---|---|---|---|
| A-B | 84 | 225 | | 190 |
| A-D | 42 | 125 | | Inf. |
| B-D | 42 | 125 | | Inf. |
| C-D | 42 | 125 | | Inf. |
| E-F | | | 50 | 5 |
| E-D | | | | 170 |
| F-D | | | | 170 |
| G-D | | | | 170 |
| G-H | | | 50 | 2.1 |
| H-D | | | | 170 |
| I-D | | | 3±.5 | .1 |
| J-D | | | 25.2 | 60 |
| G-K | 184 | 225 | | 190 |
| D-K | 42 | 125 | | Inf. |

### (9) Repair

The test outlined above will determine which parts are defective in the event the inverter does not operate satisfactorily. The defective parts should be replaced with new parts of the proper type. In replacing parts make sure that all joints and connections are clean and secure.

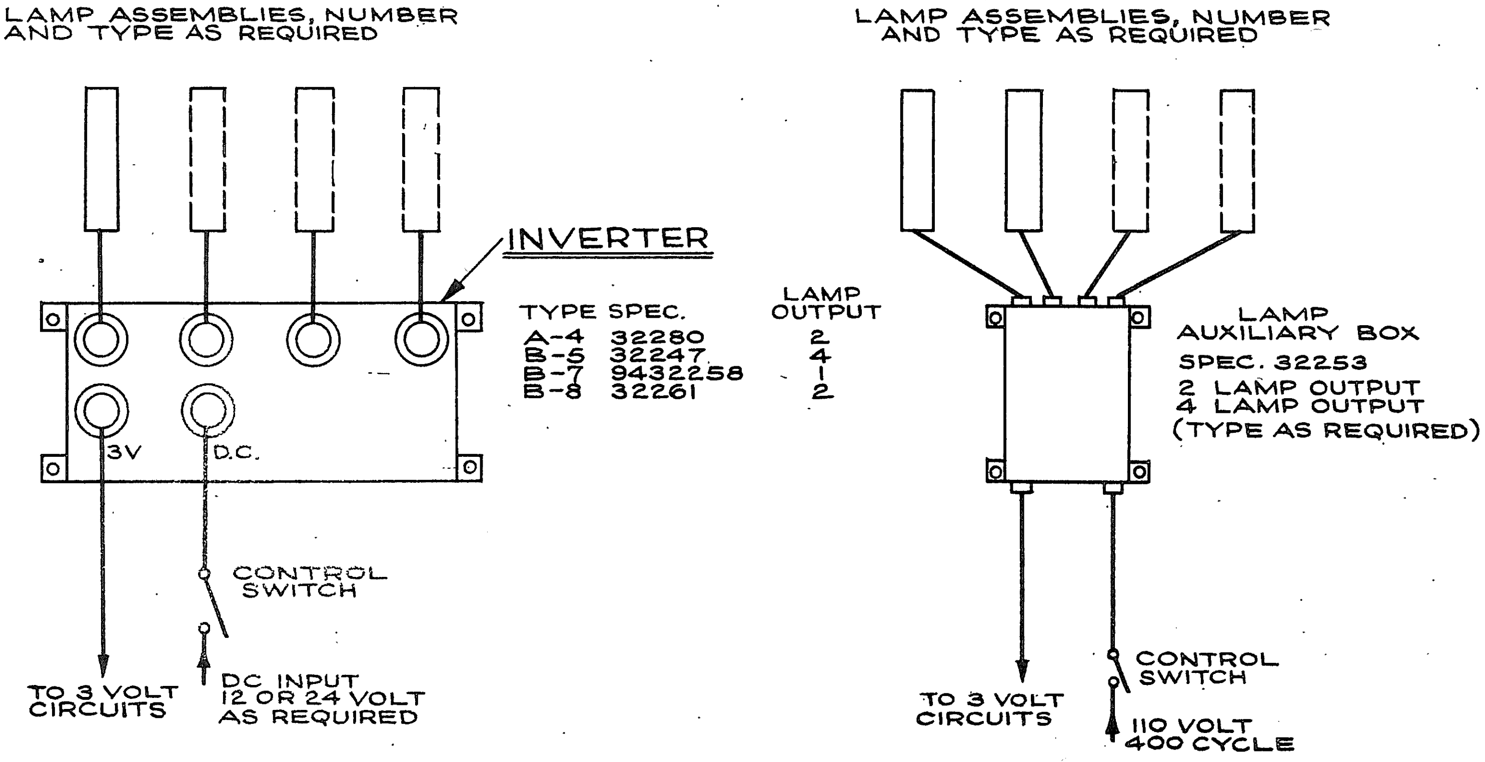
### (10) Reassembly

To test the inverters after assembly, it is very necessary to apply the rated load and check for proper performance of the fluorescent lamps and the 3 volt output.



LAMP CURRENT .145 AMP.
INPUT VOLTAGE 25.2V DC
INPUT CURRENT 3.5 AMP. MAX.
OUTPUT VOLTAGE 3V AC
±.5V @ 5 AMP.

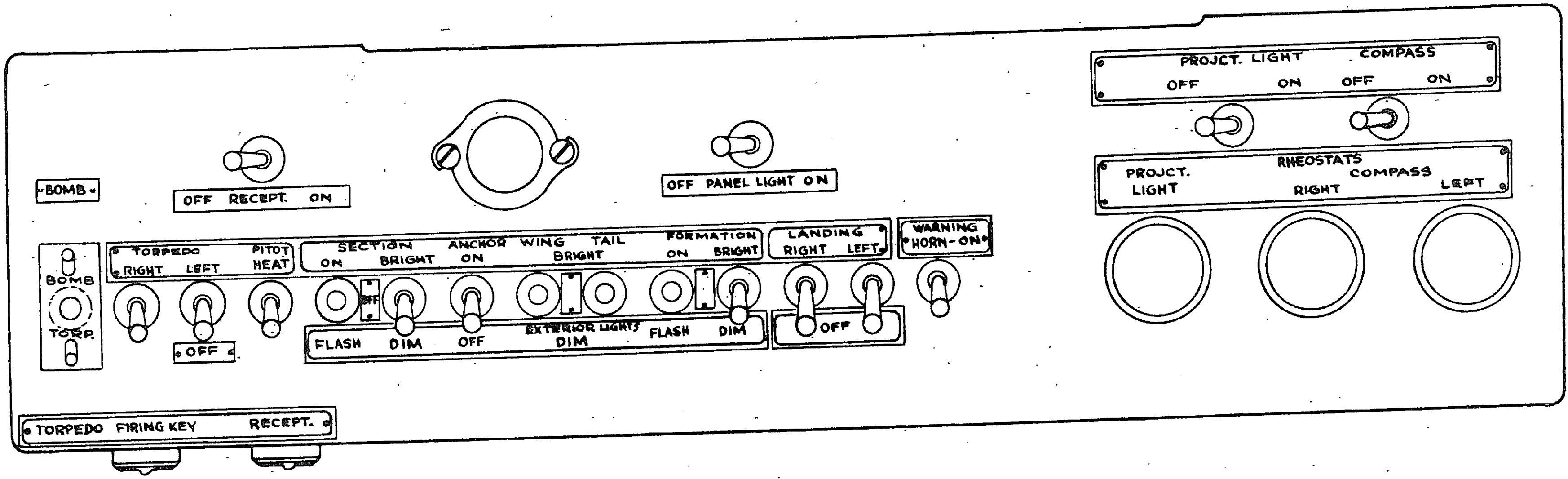
FIGURE *44A*
B-5 INVERTER TYPE S-666



| TYPE | SPEC. | LAMP OUTPUT |
|---|---|---|
| A-4 | 32280 | 2 |
| B-5 | 32247 | 4 |
| B-7 | 9432258 | 1 |
| B-8 | 32261 | 2 |

FIGURE 44B
FLUORESCENT INSTRUMENT LIGHTING SYSTEM
(WIRING DIAGRAM)

W.P.SHEKORE 4/17/42



REFER TO C.A.C. DWG. 28E5768

FIGURE 44C
PILOT'S ELECTRICAL SWITCH PANEL

Revised 4/1/42 C.A.C.

## 5. Servicing

### a. Replacement of Lights

Spare light bulbs are located near the float switch box on the forward port side of bulkhead #4.0.

### b. Replacement of Fuses

A spare fuse box is located in the main distribution panel.

## 6. Electrical Connections at Erection

### a. Center Wing Section to Hull

The superstructure fairing should be removed before lowering the center wing section on to the hull superstructure. Pull the three flexible conduits forward of bulkhead #4.0, from the hull into the wing through the openings provided in the bottom of the wing. After the center section is in place, feed the wire ends into the wing junction box through the conduit fittings. Pull up the conduit coupling nuts and screw tight. Connect the wiring to the terminal studs marked with corresponding numbers. Coil the slack into boxes and secure the covers in place.

### b. Outer Wing Panels to Center Wing Section

Before swinging, the outer wing section inboard to close the gap between the two sections, pull one flexible conduit from the outer section through the opening provided and into the center section. After the wing sections are bolted together, pull the wires through the fitting into the junction box at the end of the center section and screw the coupling nut tight on the fitting in the box. Connect the wires to the terminal studs marked with corresponding numbers. This box is accessible through hand holes on under surface of leading edge, one at each end of center section as shown on Figure

### c. Rudder to Vertical Fin

When the rudder is in place, remove the cover from the terminal box on the stern post and pass the wires through the fitting in the cover. Connect the wires to the terminal studs in the box which carries the corresponding numbers. Screw the coupling nut tight on the cover fitting. Coil the slack wire into the box and replace the cover on the box. Connect the bonding braids at each of the two rudder hinges, one top and one bottom.

### d. Nacelles to Center Section

After the engine and accessories are in place, attach wires to the terminals on the accessories, and check for the correct polarity as indicated by the wiring diagram, C.A.C. drawing 28E5000. Magneto wires are marked "LM" and "RM" for left and right magnetos, as seen from the rear of the engine. The ground cable, with a bare terminal, should be secured under the most convenient nut on the starter motor flange if the latter is not provided with a negative terminal. Screw the coupling nuts tight.

## G. Auxiliary Power Plant

### 1. Description (Ref. C.A.C. Dwg. 28F6047)

This is a single cylinder, 4 HP Eclipse (NEP-2) unit consisting of a 24-volt D.C. Type NEB-1D Generator, Bilge Pump, Shock Mounts, Control Box, Auxiliary Float Chamber and Muffler. It is located between stations #4 and #4.5 on the port side of the airplane. The generator delivers both AC and DC current.

Fuel is obtained from the port tank through a line running down the side of the hull and attaching to the unit. The valve that controls this line is located on the engineer's instrument panel, Figure 49. There is no fuel tank on the unit itself.

A tank is provided on the unit for oil and should always contain a supply of oil. The oil tank capacity is 2 gallons. Drainage of the unit can be accomplished by disconnecting the flexible fuel hose at the unit. Use SAE #70 oil for the tank.

Further details are in the instruction book furnished with the unit.

The engine is a single cylinder, 4 horsepower, Navy type, air-cooled engine. The controls for the engine are on the engine itself. Engine outlets for the muffler and bilge pump are as shown on Figure 21. Use SAE #20 oil for the gear train.

### 2. Operation

For manual starting, a starter cord is provided. For electrical control, a control box type NF-2P is provided just forward of the auxiliary power plant. The engine is held at constant speed by a built-in mechanical governor.

## H. Instruments

### 1. Description

#### a. Pilot's Instrument Panel

The pilot's instrument panel is located directly in front of the pilot's seats, mounted vertically on shock-proof mounts. The location and type numbers of the instruments may be seen on Figure 47.

The entire panel is illuminated by ultra-violet lights that may be adjusted to three degrees of intensity.

#### b. Bomber's Instruments (Ref. C.A.C. Dwg. 28F5010)

The bomber's instrument panel is located on the starboard side just above the bomber's sighting window in the nose of the hull. The instruments are illuminated by means of a projector light. The panel is secured in a vertical position on a shockproof mount.

The bomber's instruments consist of:

1 Airspeed Indicator.
1 Altimeter (Sensitive).
1 Lateral Inclinometer.
1 Electric Free Air Thermometer.

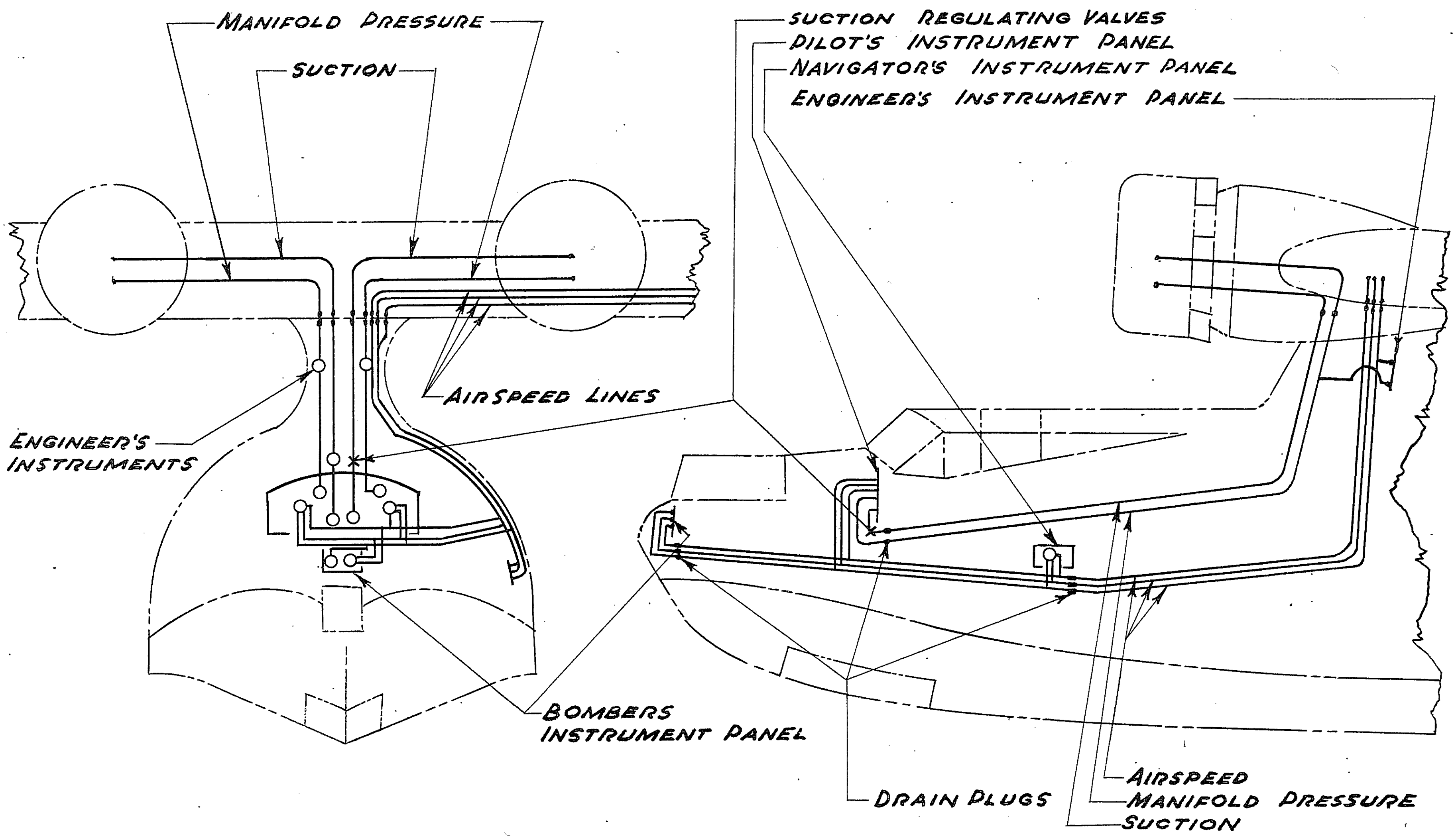
#### c. Engineer's Instruments (Ref. C.A.C. Dwg. 28F5005)

The engineer's instrument panel is located in the superstructure just aft of bulkhead #4.0 in the flight engineer's compartment. The panel is not shockproof mounted as are the other instrument panels. Illumination of the instruments is secured by means of a projector light.

The position of the instruments located on the panel is shown on Figure 49.

The fuel flow meters are located above the instrument panel. Fuel sight gages are located one at the rear and front of each tank. (See C.A.C. Dwg. 28G3002). The four sight gages are located in the engineer's compartment overhead at the fore and aft bulkheads. The engineer's inclinometer, Type 651B, is mounted on the starboard side of the compartment forward of the observation window.

See Part C of this section for a more detailed description of the instruments not on the panel. Directions for using the sight gages and the calibration chart on the starboard wall of the compartment are also given in Part C.



REFER TO C.A.C. DWG. 28F2016

FIGURE 45
INSTRUMENT LINES DIAGRAM

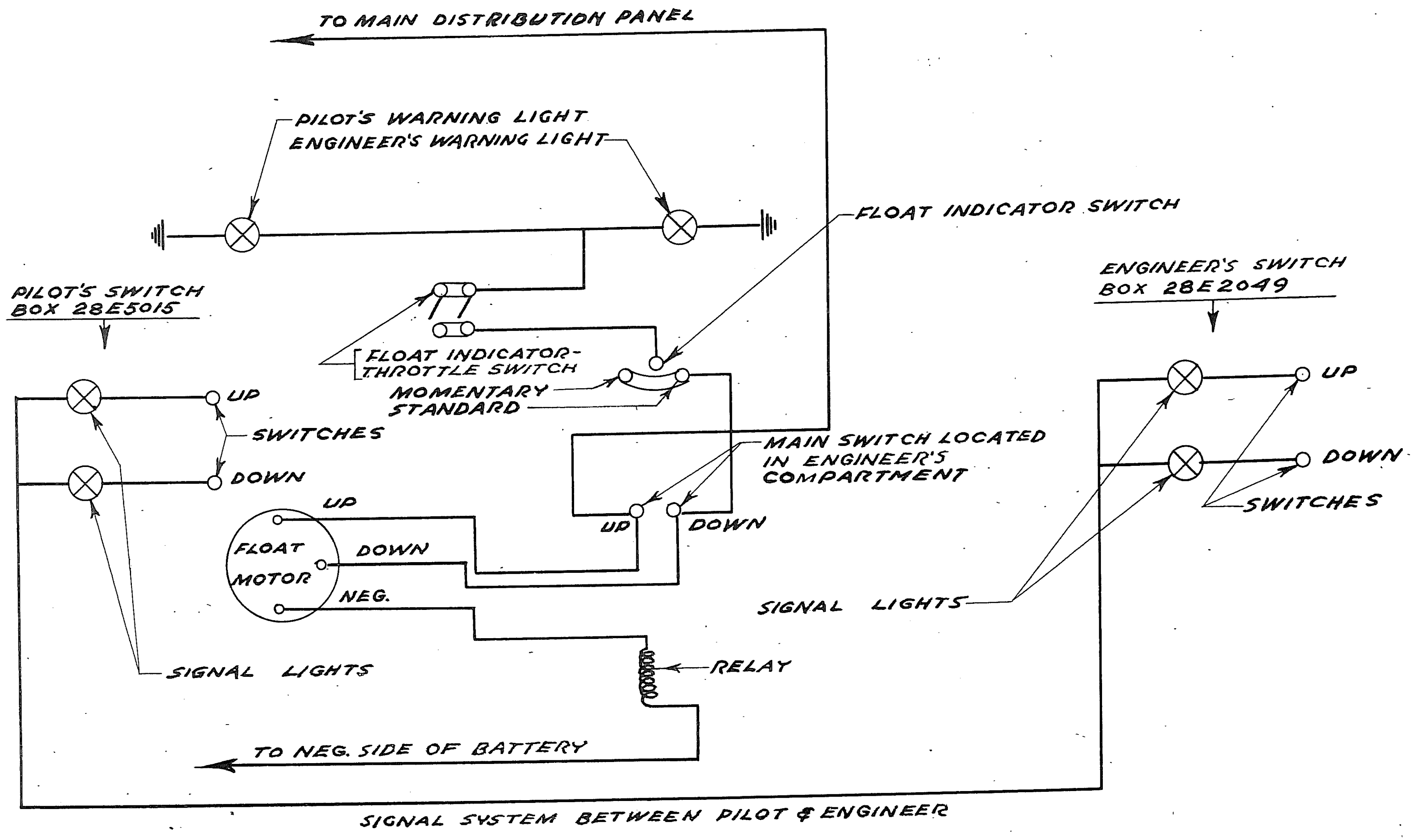
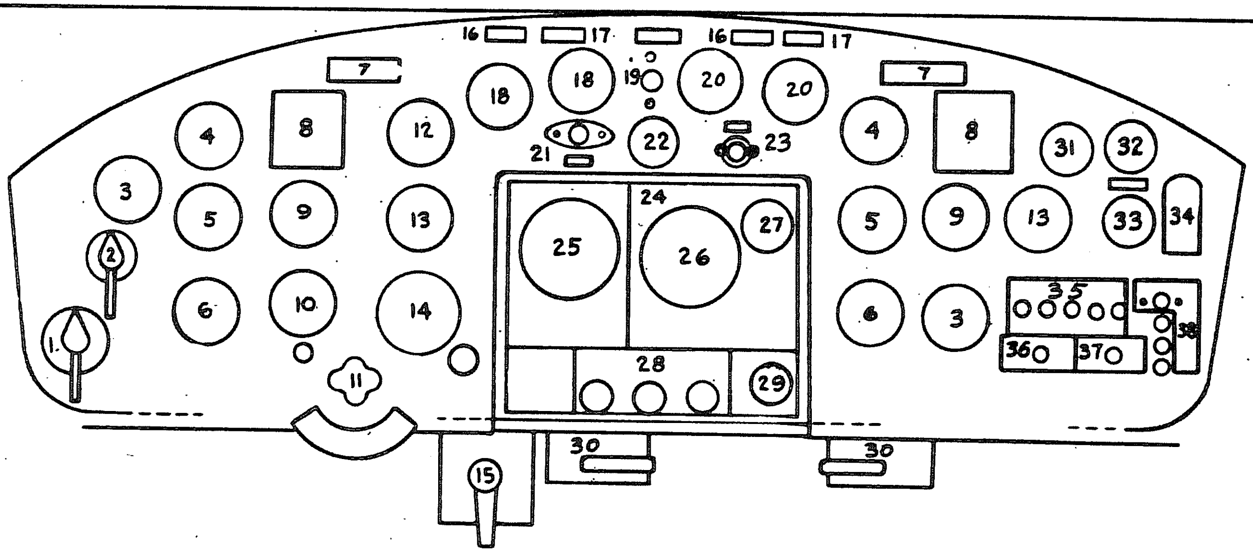

TO MAIN DISTRIBUTION PANEL
PILOT'S WARNING LIGHT
ENGINEER'S WARNING LIGHT
FLOAT INDICATOR SWITCH
PILOT'S SWITCH BOX 28E5015
ENGINEER'S SWITCH BOX 28E2049
FLOAT INDICATOR-THROTTLE SWITCH
MOMENTARY
STANDARD
UP
SWITCHES
DOWN
MAIN SWITCH LOCATED IN ENGINEER'S COMPARTMENT
UP
FLOAT MOTOR
DOWN
NEG.
UP
DOWN
UP
DOWN
SWITCHES
SIGNAL LIGHTS
SIGNAL LIGHTS
RELAY
TO NEG. SIDE OF BATTERY
SIGNAL SYSTEM BETWEEN PILOT & ENGINEER

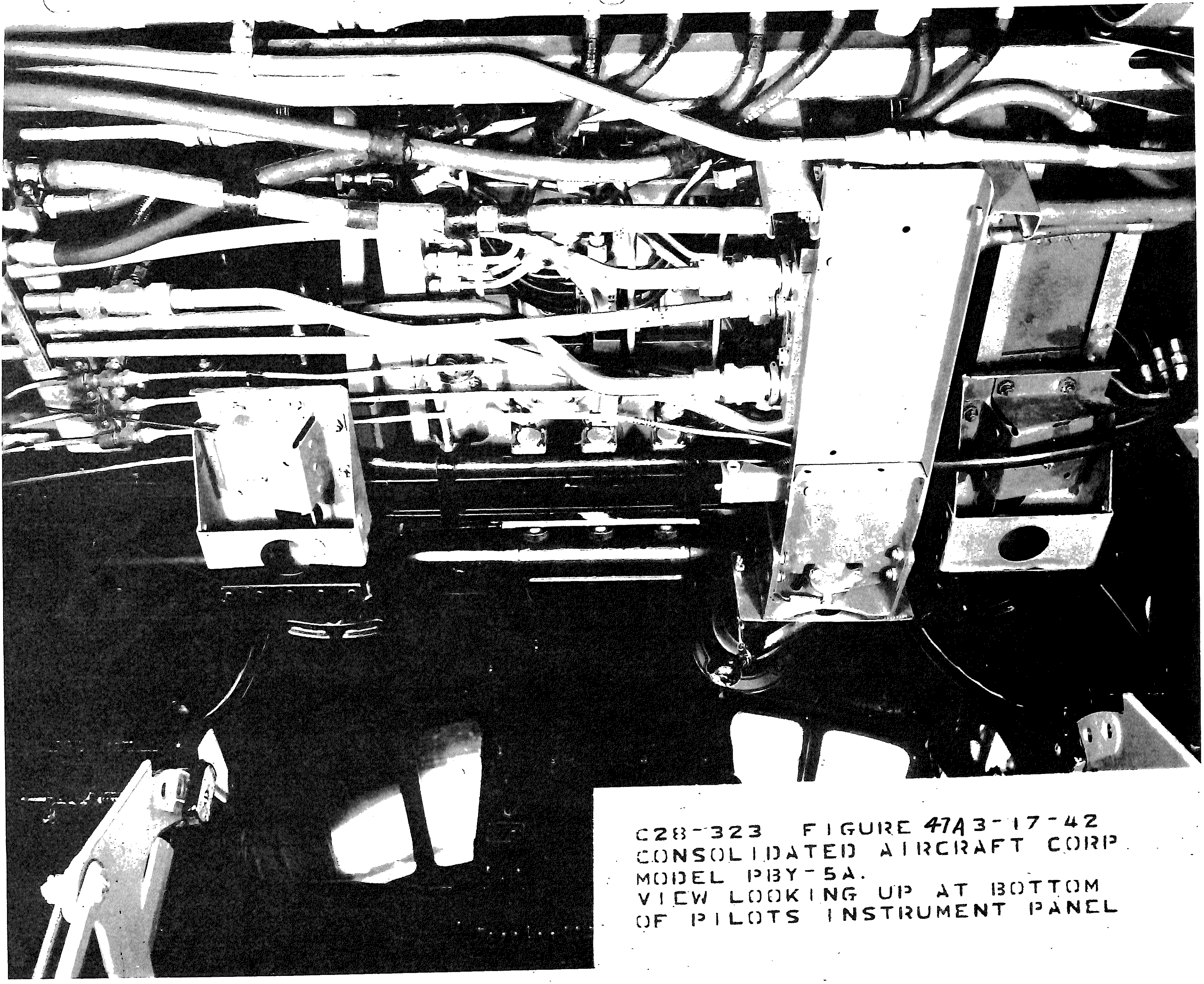
FIGURE 46
FLOAT WIRING DIAGRAM



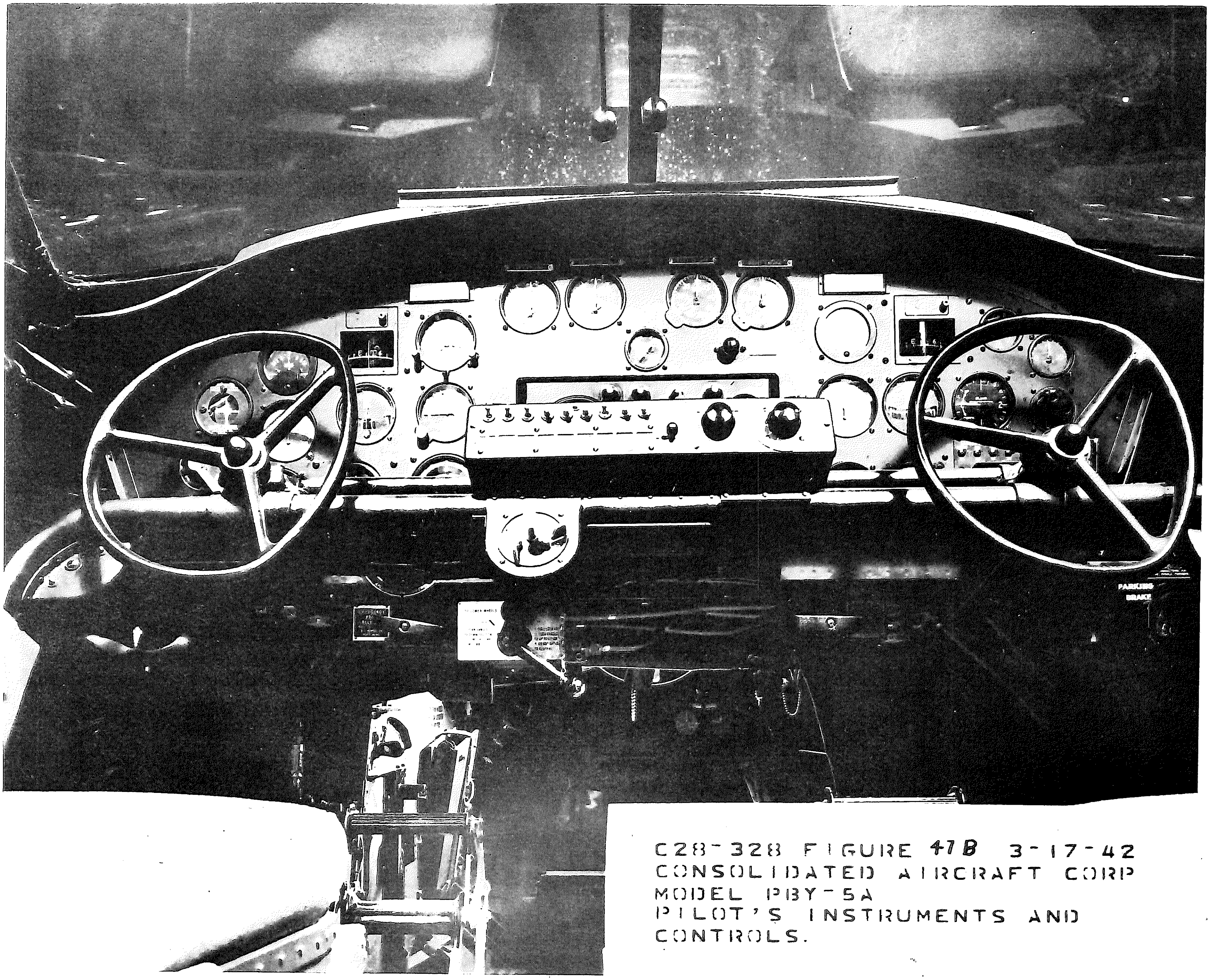
1. VACUUM SELECTOR VALVE
2. GYRO PILOT OIL VALVE
3. Z.A. BLIND LANDING INDICATOR
4. ALTIMETER
5. AIRSPEED INDICATOR
6. P. D. I.
7. COMPASS CARD
8. MARK IX COMPASS
9. TURN & BANK INDICATOR
10. DIRECTIONAL GYRO
11. AILERON TAB CONTROL
12. CLOCK
13. RATE OF CLIMB
14. GYRO HORIZON INDICATOR
15. LANDING GEAR SELECTOR VALVE
16. "LEFT" ENGINE NAMEPLATE
17. "RIGHT" ENGINE NAMEPLATE
18. TACHOMETER
19. A.B.A. CHALLENGING SWITCH
20. MANIFOLD PRESSURE GAGE
21. A.B.A. BULL'S EYE LIGHT
22. SYNCHROSCOPE
23. FLOAT WARNING LIGHT
24. MK. III AUTOMATIC PILOT
25. DIRECTIONAL GYRO CONTROL UNIT
26. BANK & CLIMB CONTROL UNIT
27. GYRO PILOT SUCTION GAGE
28. SERVO SPEED CONTROL VALVES
29. GYRO PILOT OIL PRESSURE GAGE
30. EMERGENCY BOMB RELEASE
31. DE-ICER PRESSURE GAGE
32. HYDRAULIC PRESSURE GAGE
33. TELL-TALE LIGHT
34. MFGR'S NAMEPLATE
35. AUTOMATIC FLIGHT CONTROL
36. PRECESS
37. TELL-TALE LIGHT & P.D.I.
38. LANDING GEAR WARNING LIGHTS

REFER TO C.A.C. DWG. 28F6156

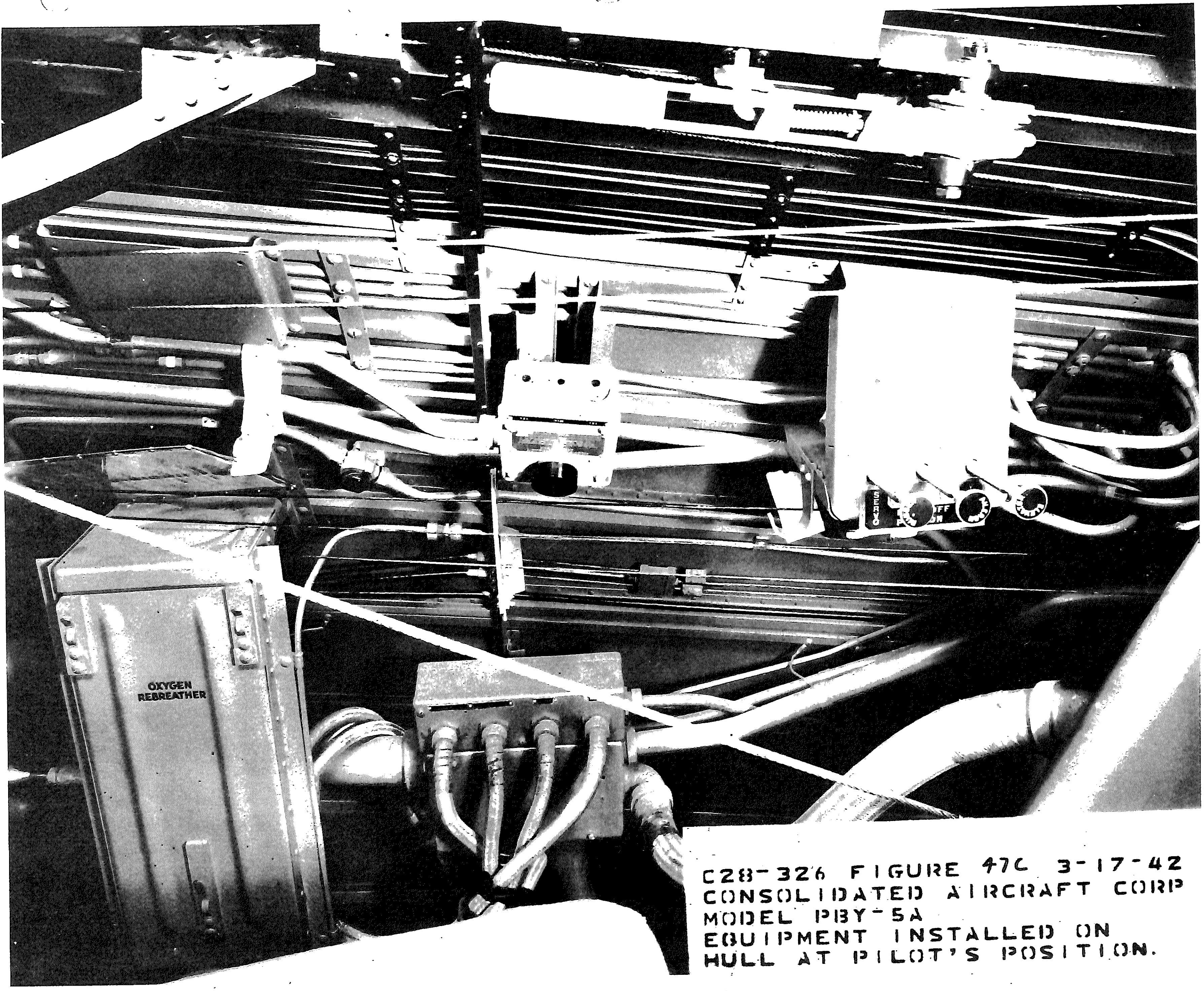
FIGURE 47
PILOT'S INSTRUMENT PANEL



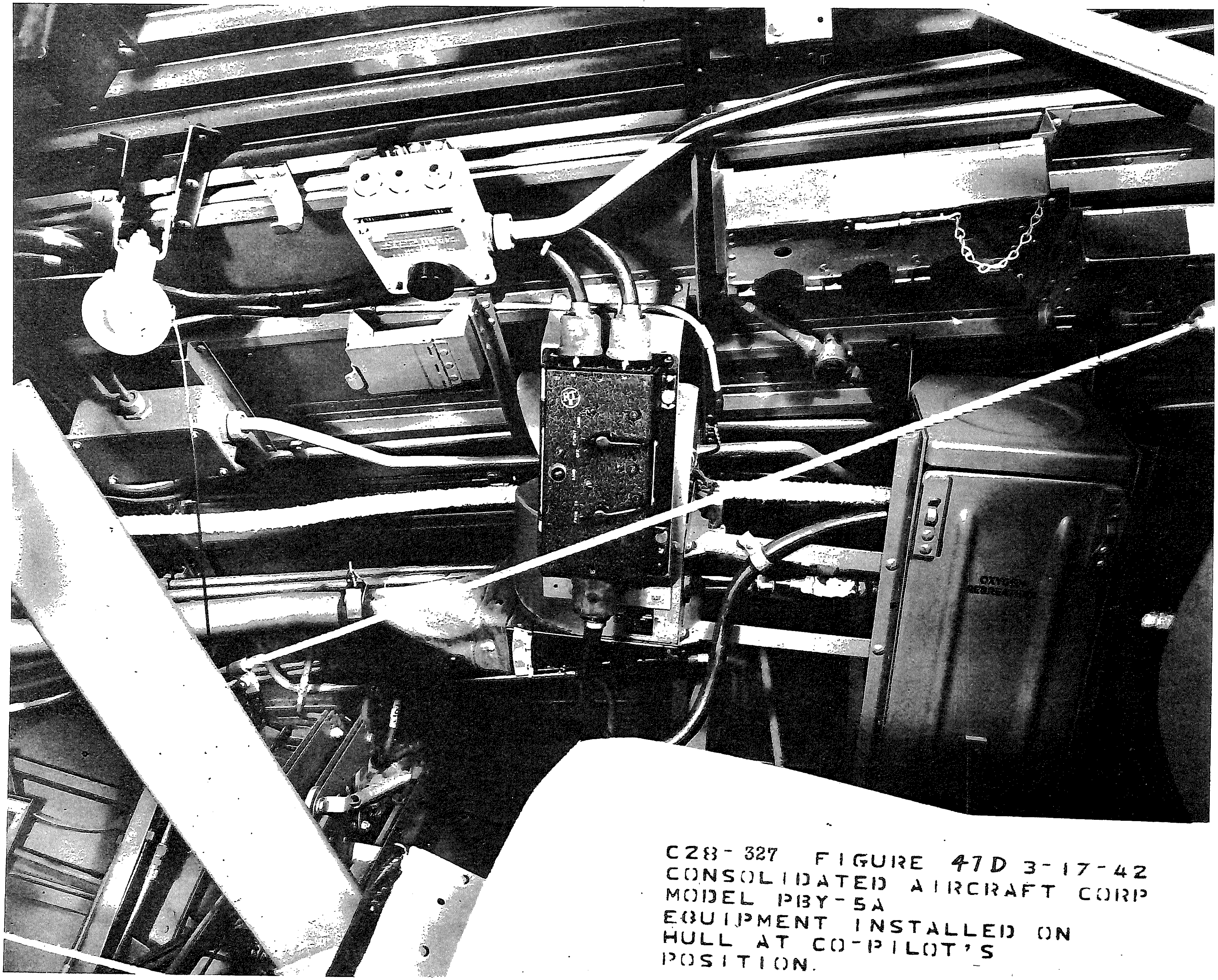
C28-323 FIGURE 47A 3-17-42
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A.
VIEW LOOKING UP AT BOTTOM
OF PILOTS INSTRUMENT PANEL



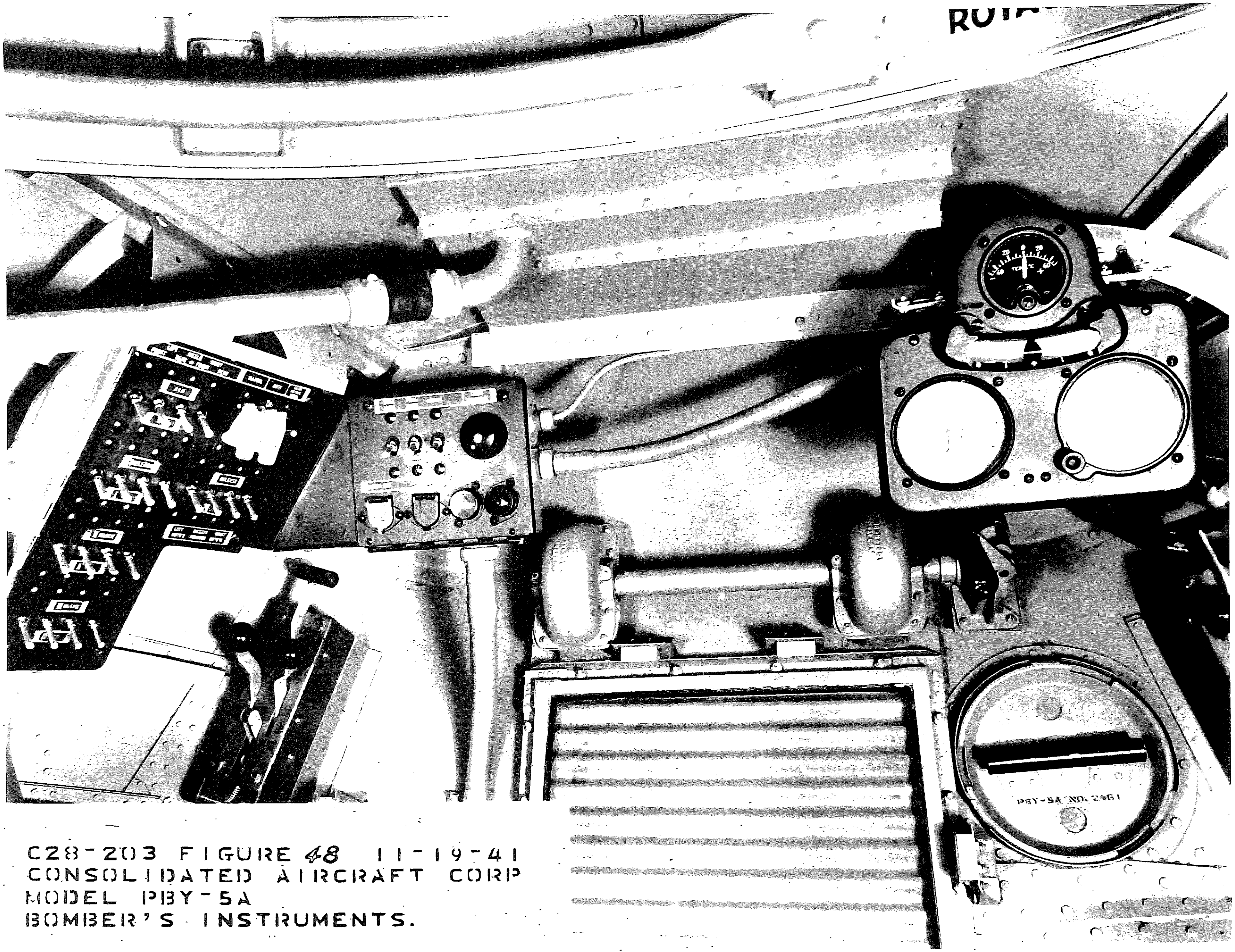
C28-328 FIGURE 47B 3-17-42
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A
PILOT'S INSTRUMENTS AND
CONTROLS.



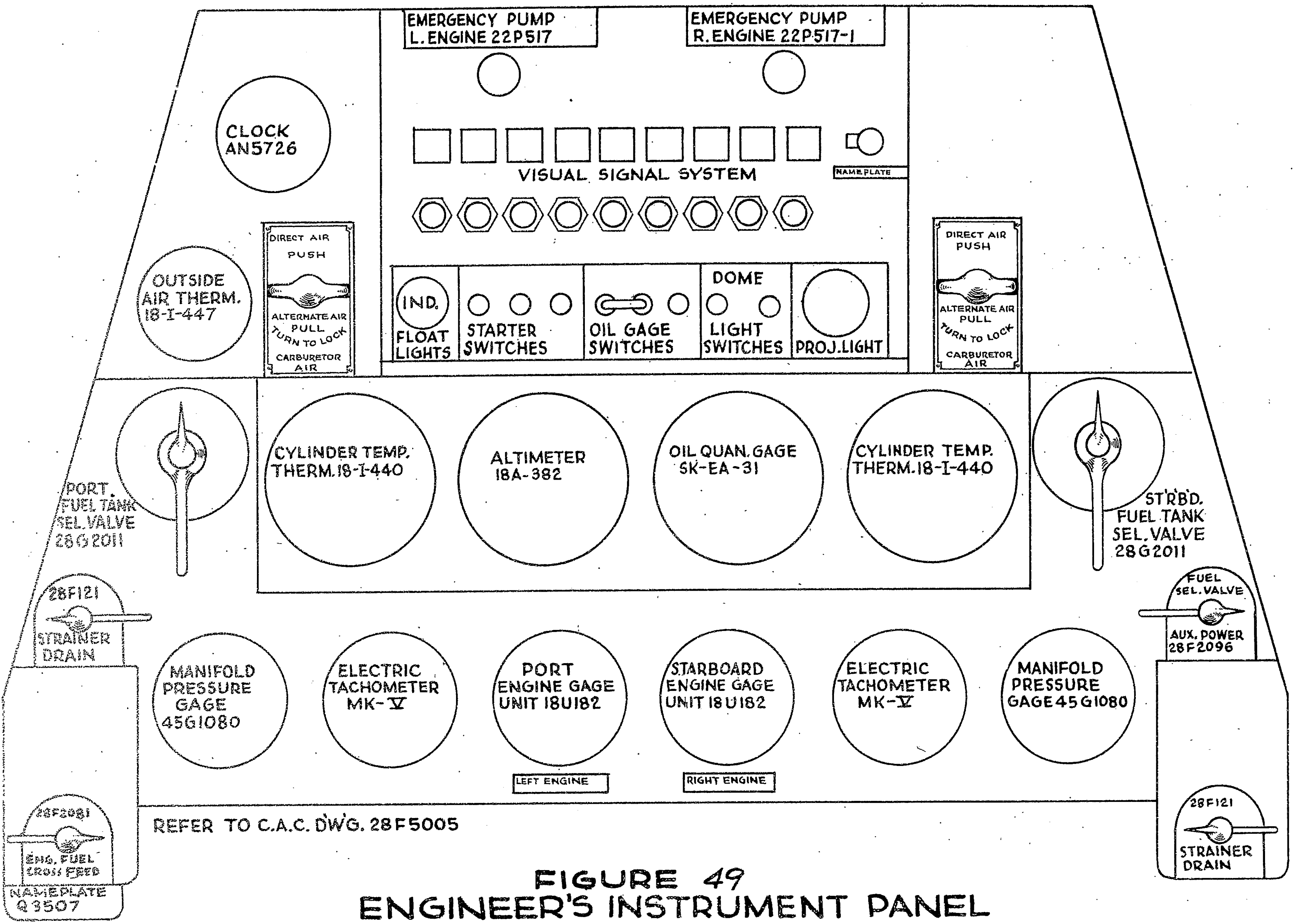
C28-326 FIGURE 47C 3-17-42
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A
EQUIPMENT INSTALLED ON
HULL AT PILOT'S POSITION.



C28- 327 FIGURE 47D 3-17-42
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A
EQUIPMENT INSTALLED ON
HULL AT CO-PILOT'S
POSITION.



C28-203 FIGURE 48 11-19-41
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A
BOMBER'S INSTRUMENTS.



REFER TO C.A.C. DWG. 28F5005

FIGURE 49
ENGINEER'S INSTRUMENT PANEL

The pitot tube is attached to a supporting strut which is attached to the leading edge of the wing outboard of the port engine. The lines extend along the leading edge of wing and down into the hull via the superstructure. The altimeters and climb indicator are connected to a special static line. The manifold pressure gage, altimeter, climb indicator and airspeed indicator lines are 3/16" outer diameter by .032" thick aluminum alloy tubing.

### f. Gyroscopic Instruments (Ref. C.A.C. Dwg. 28F5567; Figures 131 + 132

#### (1) General

The gyroscopic instruments are operated by two vacuum pumps, one mounted on the rear of each engine. The vacuum lines come to a selector valve on the pilot's instrument panel and are each provided with a suction regulating valve mounted in the rear of the pilot's panel. The gyroscopic instruments are divided into two groups, each group driven by one vacuum pump. One group includes a gyro horizon indicator, directional gyro indicator and a turn and bank indicator located on the port side of the pilot's instrument panel. Another turn and bank indicator is mounted on the starboard side of the pilot's instrument panel for the co-pilot's use.

The other group, mounted within the Mark III Automatic Pilot control unit and located at the lower center section of the pilot's instrument panel, consists of a directional gyro, a bank and climb indicator, servo speed control knobs for rudder, aileron and elevator, a vacuum pressure gage and an oil pressure gage.

Either group can be operated from either pump by means of the selector valve, thus insuring operation of desired instruments in the event of failure of one pump. The directional gyros and the artificial horizon connections are made through short lengths of flexible tube. The instrument panel is shock-mounted.

#### (2) Maintenance

The gyro horizon or directional gyro, if properly installed, should not require overhaul in less than three or four hundred hours and should not require attention other than replacement of the filter during this period. Any trouble encountered probably will be due to a clogged filter, excessive vibration or improper vacuum supply. The following table of troubles, causes and remedies will assist in determining the cause of any malfunctioning of the gyro horizon or directional gyro. All tests to be made at cruising speed, cruising RPM and in level flight.

## Gyro Horizon

| TROUBLE | CAUSE | REMEDY |
|---|---|---|
| Bar fails to respond. | No vacuum. | Examine source of vacuum supply and tubing for leaks, stoppage or pump failure. |
| | Air filter disc dirty, reducing air flow. | Examine filter disc at rear of instrument and replace if necessary. |
| | Leaks in instrument case. | See that all screws in instrument case are in place and tight. |
| Bar does not settle level. | Excessive vibration. | Check instrument board with vibrometer and if vibration is more than .004" apply shock absorbers. |
| | Low vacuum. | Check vacuum in accordance with installation instructions. |
| | Air filter disc dirty, reducing air flow. | Examine filter disc at rear of instrument and replace if necessary. |
| Bar oscillates or shimmies. | Excessive vibration. | Check instrument board with vibrometer and if vibration is more than .004" apply shock absorbers. |
| | Vacuum too high. | Check vacuum in accordance with installation instructions. |

## Directional Gyro

| TROUBLE | CAUSE | REMEDY |
|---|---|---|
| Dial spins continuously in one direction or drifts excessively in either direction. | Excessive vibration | Check instrument board with vibrometer, and if vibration is more than .004" apply shock absorbers. |
| | Incorrect vacuum. | Check vacuum in accordance with installation instructions. Should not be less that 3" Hg. or more than 5" Hg. |
| | Air filter disc dirty, reducing air flow. | Examine filter disc at bottom of instrument and replace if necessary. |

NOTE: The gyro horizon and the directional gyro should be operated on a vacuum supply of 3-1/2 to 4 inches of mercury. The rotor speed is approximately 12,000 RPM.

Build up a vacuum slowly until the manometer indicates 3-1/2" (89 mm) Hg. Then cage the instrument by pushing the caging knob in and turn caging knob to rotate the dial 360 degrees several times in both directions. This will prevent any tendency of the bearing to stick due to its inertia in transit.

Allow the instrument to run for at least 10 minutes.

Set dial on zero degree heading and pull knob out, being careful not to disturb heading when doing so.

Operate the gyro for twenty (20) minutes on each of the following four headings:

Card reading Zero (0)
Card reading Nine (9)
Card reading Eighteen (18)
Card reading Twenty-seven (27)

Note the drift of the card every five (5) minutes. The drift of the card, in azimuth, shall not exceed three (3) degrees, in either direction, for any fifteen-minute period for any of the stipulated headings. A maximum of five (5) degrees drift is permitted on any one heading when the total drift of the four headings does not exceed twelve (12) degrees. See following tables of examples:

| Heading | Drift |
|---|---|
| 0 | - 3 |
| 90 | 2 |
| 180 | 5 |
| 270 | - 2 |
| Total Drift | 12 Acceptable |

| Heading | Drift |
|---|---|
| 0 | - 3 |
| 90 | 2 |
| 180 | 5 |
| 270 | 3 |
|  | 13 Reject-<br>Excessive total |

| Heading | Drift |
|---|---|
| 0 | - 3 |
| 90 | 4 |
| 180 | 5 |
| 270 | 0 |
| Total Drift | 12 Reject - excessive drift on more than one point. |

When an instrument fails to come within the stipulated allowances described in the foregoing, it will be permissible to make two (2) additional or repeat runs of the test which failed. This may be done immediately or at the conclusion of the group in which the failure occurred. Two (2) out of the total of three (3) runs must come within the stipulated limits before the instrument may be considered acceptable.

If the vacuum is found to be correct and vibration not excessive, and the trouble still exists, the cause is probably due to worn pivots or bearings. In such a case, the instrument should be removed from the airplane for inspection, in accordance with the instructions under Lubrication and Inspection.

IMPORTANT: Under no condition should either the gyro horizon or the directional gyro be taken apart by anyone not authorized to do so.

Removal of the air filter disc for renewing is not considered as disassembling the instrument and does not require removal of the instrument from the airplane.

To Renew Filter Disc (gyro horizon)-- Lift out the snap ring that retains the filter disc at the rear of the case. Remove the filter disc and replace with a new one. New filter discs may be obtained from the Sperry Gyroscope Company, Inc.

To Renew Filter Disc (directional gyro) -- Lift out the snap ring that retains the filter disc at the bottom of the case with a scribe. Replace the filter disc with a new one.

### (3) Lubrication and Inspection

The shafts, pivots and ball bearings of the instrument are lubricated before assembly in the case, and ordinarily, no further lubrication will be required. It should be borne in mind, however, that continuous use of the instrument in hot climates increases the evaporation of its oil, and replenishing may become necessary.

After every 300 to 400 hours of operation it is advisable to have the instrument removed from the airplane and inspected, only, however, by an authorized instrument service station which has at its disposal the special tools and fixtures necessary for disassembly, inspection and calibration of gyro horizons and directional gyros. Otherwise, the instrument should be returned to the Sperry Gyroscope Company, Inc. or their representative, for inspection. For gyro horizon, insert lock screw unless the model has a caging device, in which case simply turn the knob to cage the gyro. For directional gyro, be sure caging knob is pushed in. Pack the instruments carefully, preferably in the same boxes in which they were received.

### (4) Testing the Directional Gyro

Place the directional gyro on the testing block in a level position and connect it exactly as described for the gyro horizon.

In order to insure a standard method of testing, the vacuum must be maintained at 3-1/2" (89 mm) Hg., and must not fluctuate more than 1/8" (3 mm) during tests. This applies to both the gyro horizon and the directional gyro.

On completion of the foregoing test, the directional gyro is ready for installation.

For complete service and maintenance of the Sperry gyro instruments, refer to Instruction Bulletin No. 15-405-B, dated June 1940, or Instruction Bulletin #15-410, February 1942, Sperry Gyroscope Company, Inc., Manhattan Bridge Plaza, Brooklyn, N.Y. Also see Figures

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### b. Automatic Pilot

#### (1) General

The automatic pilot equipment consists essentially of a directional gyro control unit, a bank and climb gyro control unit, a mounting unit and a servo unit, together with necessary accessories for the power operation of the equipment as a whole. A detailed description of the automatic pilot is given in Section II of the Sperry Instruction Book, #15-729, "Instructions for the Installation, Operation and Maintenance of the Sperry Gyropilot, Mark III. The directional gyro control unit, the bank and climb gyro control unit, and the mounting unit are located in the center of the pilot's instrument panel.

The engaging lever, is located on the ceiling of the pilot's compartment immediately aft of the elevator and rudder control box. Cables from the lever extend aft to the valve pulley on the servo jacks.

The automatic pilot servo unit is located on the port side of the hull between bulkheads #3 and #4. It consists of three servo jacks. Each jack is connected in series with the main control cable that it actuates. The follow-up cables connect to the forward end of the jack rods and run forward to the control unit located in the pilot's compartment.

Figure 57 shows the hydraulic system piping diagram. Lines lead from the engine-driven pump in the starboard nacelle pump through Sperry Relief Valve to the manual oil control valve on the pilot's instrument panel. When this valve is on, oil under pressure is led through the automatic control system. If the manual oil control valve is "OFF", the oil coming from the pump under pressure is by-passed back through the hydraulic selector valve to the reservoir in the nacelle.

The gyropilot manual oil control valve is located on the lower left hand corner of the pilot's instrument panel.

A hydraulically-driven sump pump, a restrictor, an oil filter and Sperry manifold block are all located on the aft port face of bulkhead #1. The oil filter is located on the aft starboard side of bulkhead #1 and the manifold in the center of bulkhead #1.

The sump pump causes oil to flow from the gyropilot drain ~~to~~ the oil return line which extends to the reservoir in the engine nacelle.

The follow-up system consists of single cables which connect the forward end of the control jacks to the Sperry control box.

The speed control valves are located on the Sperry Control Unit.

An oil pressure gage is mounted in the gyropilot mounting unit.

The vacuum pumps supply the necessary vacuum to run the Sperry system instruments. A vacuum pump selector valve located in the lower left hand corner of the pilot's instrument panel is used to select either pump to run the automatic pilot while the alternate pump supplies a vacuum to the instruments.

The pressure side of the nacelle vacuum pumps supply air to the de-icer system.

### (2) Operating Instructions

Detailed operating instructions are given in the Sperry instruction book #15-729, "Instructions for the Installation, Operation, and Maintenance of the Sperry Gyropilot, Mark III".

These books should be studied for a complete understanding of the system in conjunction with this section.

To engage the Sperry Pilot during flight the pilot should:

(a) Turn the manual oil control valve on the port side of the pilot's instrument panel to the "ON" position.

(b) Check three servo unit oil valves outboard of the pilot to see that they are in the "ON" position.

Proceed as outlined in the Sperry Instruction Book, #15-729.

The manual oil control valve should be in the "OFF" position when the automatic pilot is not in use, or when the engines are stopped, in order to prevent the oil in the reservoir from seeping through the gyropilot and escaping out of the gyropilot oil drain.

### (3) Service and Maintenance

#### (a) Cleaning and Lubrication

Parts which require cleaning are covered in the overhaul check periods which follow. The internal parts of the control units will require cleaning and oiling only at the 600-800 hour check period when they are removed from the airplane and completely overhauled. The only other lubrication required in the entire system is to refill the sump and to oil the follow-up pulleys as directed in the 50-100 hour check period, below.

#### (b) Adjusting

Adjustments to vacuum relief valve, oil pressure regulator, and other parts of the equipment are given where necessary under Trouble Shooting. Adjustments which may be made during flight, such as speed control valve, directional gyro drift, lateral control, etc. are given in the section on Operation. Instructions for the adjustment of the servo relief valves and the balanced oil valves are given under the 300-400 hour (Engine Overhaul Period.

### (c) Periodic Inspection and Maintenance

The purpose of any inspection and maintenance is to forestall trouble or failure by detecting maladjustment, wear or weakness before it becomes serious and to make the necessary correction to prevent a failure of the apparatus. The inspection periods mentioned can only be suggestive since their actual required frequency will depend largely on the service to which the apparatus is subjected. It is suggested that the minimum periods be used, until the user becomes thoroughly familiar with the apparatus.

### (d) 50-100 Hour Check

Inspect all piping and fittings including flexible hoses. Tighten or replace fittings or pipes where necessary to stop leaks. Replace any flexible hoses showing signs of seepage at connections or pimples on surface of hose. Tighten servo packing nuts if there is any leakage. Caution: Do not tighten excessively, as packing leathers are pressure-sealed and excessive tightening will produce binding on servo rod.

Inspect all cables, cable connections and pulleys. Main cables, follow-up cables and servo ON-OFF cables should be free working, positive, and free from any signs of fraying or wear.

Check follow-up pulleys on Mounting Unit with gyro control units removed, and oil springs, if dry. A few drops of engine oil is sufficient.

Inspect and replace if necessary air filter element in the air filter and clean air intake screen in vacuum relief valve.

Drain oil in sump tank. Remove filter element from the oil filter, clean in gasoline, and replace. Refill sump with new oil. Should be 3/4 full. Use Sperry servo oil, P-69555.

### 300-400 Hour (Engine Overhaul) Period

Perform all operations called for in 50-100 hour check.

Remove gyro control units and have bench check made in instrument shop. Overhaul if performance is not satisfactory. Replace rubber grommets if necessary.

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Drain oil sump.

Remove strainer from sump, clean in gasoline, and replace.

Remove oil and vacuum pumps. Wash in gasoline and inspect driving end for wear. Check freedom of rotation. Do not disassemble the pumps unless absolutely necessary. If facilities are available, have pumps checked for performance.

Inspect shock-absorbing bushings on Mounting Unit and replace if necessary.

### (e) 600-800 Hour Period

Note: Operations recommended at this time should only be performed by organizations trained in the overhaul of Gyropilot equipment and having the necessary special tools and fixtures required.

The following units should be removed and overhauled to put them in first class operating condition:

Directional Gyro Control Unit, Bank and Climb Gyro Unit, Balanced Oil Valves, Oil Sump, Pressure Regulator, Oil Filter, Oil Pump and Vacuum Pump.

The following units should be removed and tested but not disassembled for overhaul unless their performance is not satisfactory:

Air Relays, Speed Control Valves, Vacuum Relief Valve and Servo Unit.

The construction of these units is such that there is little chance of internal wear.

Re-install all units and make all checks recommended for the more frequent periods.

### (f) Trouble Shooting

In order to obtain ground test at all, it is necessary to have the proper vacuum, oil in the sump, and oil pressure. Possible causes of vacuum and oil troubles are listed below and followed by other troubles which might occur when vacuum and oil pressure are sufficient.

LOW OR NO VACUUM (Under 3" Hg.)

| Causes | Remedies |
|---|---|
| Vacuum relief valve set too low. | Screw in adjusting screw. If increased vacuum does not result, valve is de- |

## LOW OR NO VACUUM(Under 3"Hg.)(Con't)

| Causes | Remedies |
|---|---|
| | fective or trouble lies elsewhere. If vacuum does not jump with hand held over air intake of valve, trouble is definitely elsewhere. |
| Pump failure. | Repair or replace pump. Be sure that some other defect in the installation is not responsible for pump failure. |
| Leak or break in vacuum line. | Locate and repair. |
| Obstruction in vacuum line (may be collapsed inner wall of flexible hose). | Locate and repair. |
| Excessive line drop | Tee a suction gauge into the pump end of the vacuum line. With a suction of 7" mercury at the pump, it should be possible to obtain 4" mercury at the Gyropilot. (Vacuum at the pump should not exceed 10 inches). If there is evidence of exessive line drop, recheck the installation in accordance with vacuum system installation instructions. |
| Pump lines reversed. (If a check valve has not been installed, the control units will be damaged by oil from the pump discharge. | Check installation and connect lines correctly. |

## EXCESSIVE VACUUM (Over 5"Hg.)

| Causes | Remedies |
|---|---|
| Vacuum relief valve set too high. | Reset. |
| Air intake filter clogged | Replace with new filter element. |
| Vacuum relief valve stuck closed. | Remove screen and push valve free with finger. Replace screen. If sticking persists, replace or repair. |
| Shipping plug not removed from inlet end of air filter. | Remove plug. |

## LOW OR NO OIL PRESSURE

| Causes | Remedies |
|---|---|
| Insufficient oil in system. | Fill sump 3/4 full. After running engine 5 minutes with servo speed control valves open, refill to make up for oil fed into system. |
| Pressure regulator out of adjustment. | Adjust with speed valves closed. Remove cap and loosen locknut. Screw in to raise pressure, out to lower pressure. |
| Pressure regulator dirty or defective. | Clean, or repair and readjust. |
| Pump intake line or filter clogged. | Check line and filter. |
| Defective oil pump. | Test and replace if necessary. |
| By-pass valve open. | Close by-pass. |
| Broken line or leak. | Locate and repair. |

## EXCESSIVE OIL PRESSURE

| Causes | Remedies |
|---|---|
| Oil pressure regulator set too high. | Adjust with speed valves closed. Remove cap and loosen locknut. Screw out to reduce pressure. |
| Oil pressure regulator stuck. | Clean and readjust. |

## FOAMING OF OIL

Foaming of oil is invariably caused by a leak in the line leading from the sump to the oil pump inlet or by a leak in the pump itself. In either case, the leak is not usually externally apparent. Being on the suction side of the system, air leaks in instead of oil leaking out. Air mixes with the oil, creating a foam which is of much greater volume than the oil itself. The excess volume is discharged from the sump vent, causing loss of oil from the system.

## NO OPERATION OF ANY CONTROL

Failure to operate all three controls in either direction can be attributed to the following causes:

| Causes | Remedies |
|---|---|
| Low or no oil pressure | Refer to paragraph Low or No Oil Pressure. |

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| Causes | Remedies |
|---|---|
| Low or no vacuum | Refer to paragraph Low or No Vacuum. |
| Engaging lever OFF | Set to ON. |
| Gyropilot OFF due to reversed or broken connection between ON-OFF control and servo. | Check for full 90° throw of valve at servo. With engines not running, controls should be free with Gyropilot OFF and feel locked with Gyropilot ON. |
| Speed control valves closed. | Open speed control valves 2 to 4 turns. |

## FAILURE OF ONE OF THE CONTROLS

| | |
|---|---|
| Speed valve closed. | Open speed valve. |
| Servo relief valve by-passing. | Reset valve. |
| Balanced oil valve on mounting unit stuck. | Remove rear cap and work valve back and forth by hand with oil pressure on, Gyropilot off. |
| Defective control unit. (NOTE: If light sucking and blowing on the air relay produces control operation, the trouble is probably in the control unit.) | Replace-examine control unit for condition of rubber grommets at rear. |
| Air relay stuck. | Clean or replace. |

## CONTROLS HUNTING

| Causes | Remedies |
|---|---|
| Air in oil system | Move controls back and forth manually with engine running and Gyropilot OFF. Hold each control at one and then the other extreme position for one minute. This permits continuous flow of oil down one servo line, through the bypass and into the other line, thus carrying any air back to the sump via the exhaust line. The follow-up indices should be set neutral at the start with the controls at neutral. |

| Causes | Remedies |
|---|---|
| Lag in follow-up cable hook-up caused by friction which would eventually return the follow-up to datum too late and cause over-travel, thereby reversing control. | Examine follow-up system cable and pulleys to see that indices are dead beat with controls. Remove any lag present. |
| Sticking oil valve. | Work valve manually until free- then hold at each extreme position for about 2 minutes to allow any dirt to be carried back to the sump. This to be done with Gyropilot engaging lever in OFF position. |
| Unbalanced oil valve. | Reset valve to neutral. |
| End play in oil valve. | Reset balanced oil valve. |
| Gyros caged. A caged gyro will precess back and forth against the caging stops, causing the controls to follow. | Uncage gyros. |
| Incorrect speed valve adjustment for the particular airplane or air condition. | Reduce speed valve setting. |

## JERKY CONTROL

| Causes | Remedies |
|---|---|
| Sticking in follow-up pulleys. | Remove control boxes and check condition of spring and bearing. Re-lubricate if necessary. |
| Excess friction in follow-up cable, between servo and follow-up pulleys. | Examine follow-up cable system and pulleys and free-up. |
| Sticky balanced oil valve. | Free valve. Clean if necessary. Valve will have to be rebalanced if removed for cleaning. |

## LAGGING CONTROL IN ONE DIRECTION ONLY

| Causes | Remedies |
|---|---|
| Follow-up pulley not wound sufficiently | Shorten follow-up cable so that when control is hard |

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| Causes | Remedies |
|---|---|
| | over in the direction to wind the spring, the spring will be within 1/4 turn of being wound tight. |
| Dirt in balanced oil valve restricting travel in one direction. | Free valve. Clean if necessary. Rebalance after reassembly. |
| Oil valve not properly balanced. | Balance oil valve with control units removed. Replace control unit and recheck. |
| Unbalanced air cut-off in control unit. | Remove control unit and determine if control speed is equal in both directions when same pressure is applied to either side of air relay, which would indicated trouble in the control unit. Check operation with a control unit known to be good. Repair or replace defective control unit. |

### LAGGING CONTROL IN BOTH DIRECTIONS

| Causes | Remedies |
|---|---|
| Speed control valves closed too much. | Open valves. |
| Oil pressure too low. | Reset pressure regulator to amount previously known to be satisfactory. |
| Oil supply choked. | Examine interior of flexible hose, especially suction line to pump. Check oil supply lines and oil filter and clean if necessary. |
| Vacuum too low to give full travel of air relay and balanced oil valve. | Adjust regulator to 4" Hg. |
| Servo relief valve set too low. | Check in accordance with instructions given under paragraph To Check Servo Relief Valves for Blow-Off Pressure. |

### CONTROL IN ONE DIRECTION ONLY

| Causes | Remedies |
|---|---|
| Balanced oil valve restricted by dirt. | Operate manually to check. Free and clean valve if cause of trouble. |

| Causes | Remedies |
|---|---|
| Follow-up of piping reversed. | Connect according to control diagram. |
| Air leak at air pick-off grommet between control unit and mounting bracket. | Install new grommet and check. |

## CONTROL MOVES TO EXTREME POSITION WHEN GYROPILOT IS TURNED ON

If this takes place, repeat a few times, turning the Gyropilot ON with the follow-up index first to one side and then to the other side of the gyro index. If the control always moves the same way, check as explained in paragraph Control in One Direction Only. If it moves either way, always to take the follow-up index away from the gyro index, check as follows:

| | |
|---|---|
| Reversed connections between balanced oil valve and servo. | Check with diagram and correct. |
| Follow-up direction reversed. | Check with diagram and correct. |

REVERSED CONTROL - Control moves in wrong direction in response to knob movement (stopping with follow-up index matching gyro index).

This can only be caused by a reversed follow-up plus reversed connections between the balanced oil valve and the servo. Check both with diagram and correct.

## REVERSED FOLLOW-UP CABLES

A reversed follow-up cable will cause a control to move in the wrong direction to one or the other extreme positions when the Gyropilot is turned on. The follow-up pointer will move away from coincidence with the gyro indication instead of toward it. The connections should be checked first at the follow-up pulleys, rechecked in the cockpit as follows:

Right rudder should move the rudder follow-up card to the left.

Right Aileron should move the aileron follow-up index to the right.

Down Elevator should move the elevator follow-up index up.

## REVERSED SERVO OIL LINES

If the connections between a balanced oil valve and a servo cylinder are reversed, opposite control will result, continuing to the end of the control travel.

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For complete service and maintenance of the system see the Sperry Instruction Book, #15-729, "Instructions for Installation, Operation and Maintenance of the Sperry Gyro-pilot Mark III. Also see Section IV, Part J-6 hereof for instructions on hydraulic system for the automatic pilot.

## 2. Installation

CAUTION: ALL INSTRUMENTS SHALL BE BACK MOUNTED ON THE PANEL EXCEPT WHERE CLEARANCE FOR INSTRUMENTS IS REQUIRED ON ENGINEER'S PANEL.

All instruments are so arranged that they can be removed with a minimum disassembly of panels, etc. When the wing is to be removed from the hull, it is necessary to disconnect all the airspeed and de-icer lines at the junction of the leading edge and superstructure. Unions are provided for this purpose. Similarly, manifold, vacuum, fuel and oil lines must be disconnected. In addition, it is necessary to disconnect the thermocouple leads at the firewalls and withdraw them through the leading edge.

## 3. Maintenance

Drain plugs are provided in the airspeed and vacuum lines at each low point; namely, at each instrument panel that contains instruments using suction lines. These plugs should be removed at each 30-hour check to allow water to drain that has collected from condensation, etc. They are shown on Figure .

Shock mountings should be replaced at first signs of deterioration.

## 4. Pre-Flight Check

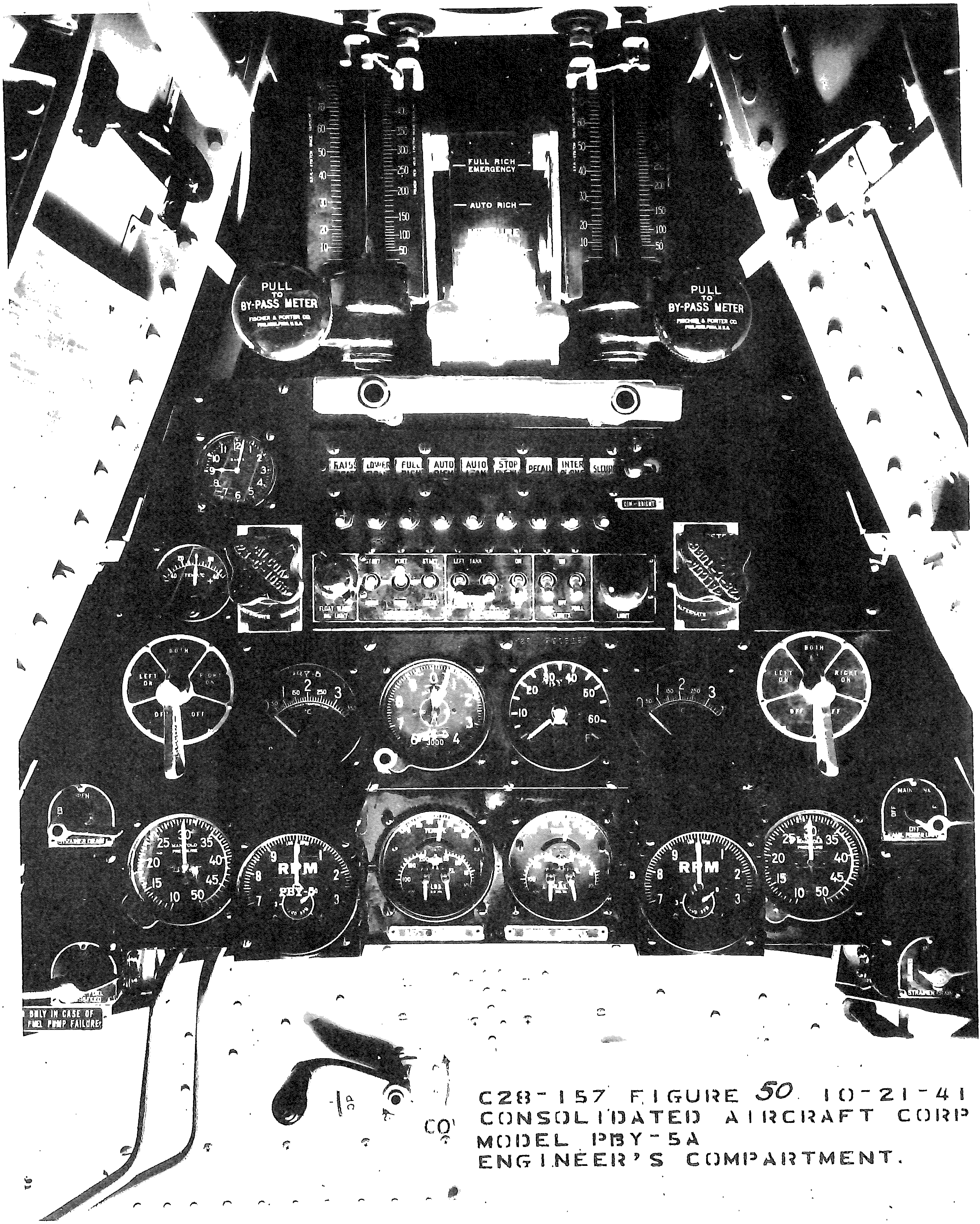
Check vacuum selector valve on left side of instrument panel to be sure that main vacuum lines are not crossed. Check vacuum on all gyro instruments and their respective operation. Following is a list of tolerances:

| | | |
|---|---|---|
| Gyro Horizon | 4" | Hg. plus or minus 1/4" |
| Directional Gyro | 4" | Hg. plus or minus 1/4" |
| Bank and Turn Indicator | 2-1/4" | Hg. plus or minus 1/4" |

All readings should be taken from each instrument and from each engine by turning vacuum selector valve. Reading should be taken at 1275 to 1500 RPM. Readings should be taken at 2400 RPM during time of power run to determine that vacuum will not run higher than that stated above.

A check of four different settings of 15 minutes each should be made on all directional gyros at 4" Hg. This is to check for excessive drift of not more than 4 degrees on any one setting or 12 degrees drift on all four settings. Settings should be 0° - 90° - 180° - and 270°.

Gyro horizons should be uncaged to check that there is no precession (falling off position) and that instruments indication will be that of the ship's position.



C28-157 FIGURE 50 10-21-41
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A
ENGINEER'S COMPARTMENT.

d. Navigator's Instruments (Ref. C.A.C. Drawing 28F5017)

The navigator's instrument panel is shock mounted on the port side of the airplane just aft of bulkhead #3. A projector light is installed just forward of bulkhead #3 over the navigator's table and provides illumination for the instrument panel and table.

The navigator's instruments consist of the following:

Airspeed Indicator

Clock

Altimeter

Electric Air Thermometer

Drift Sight (installed on the navigator's table)

Astrograph

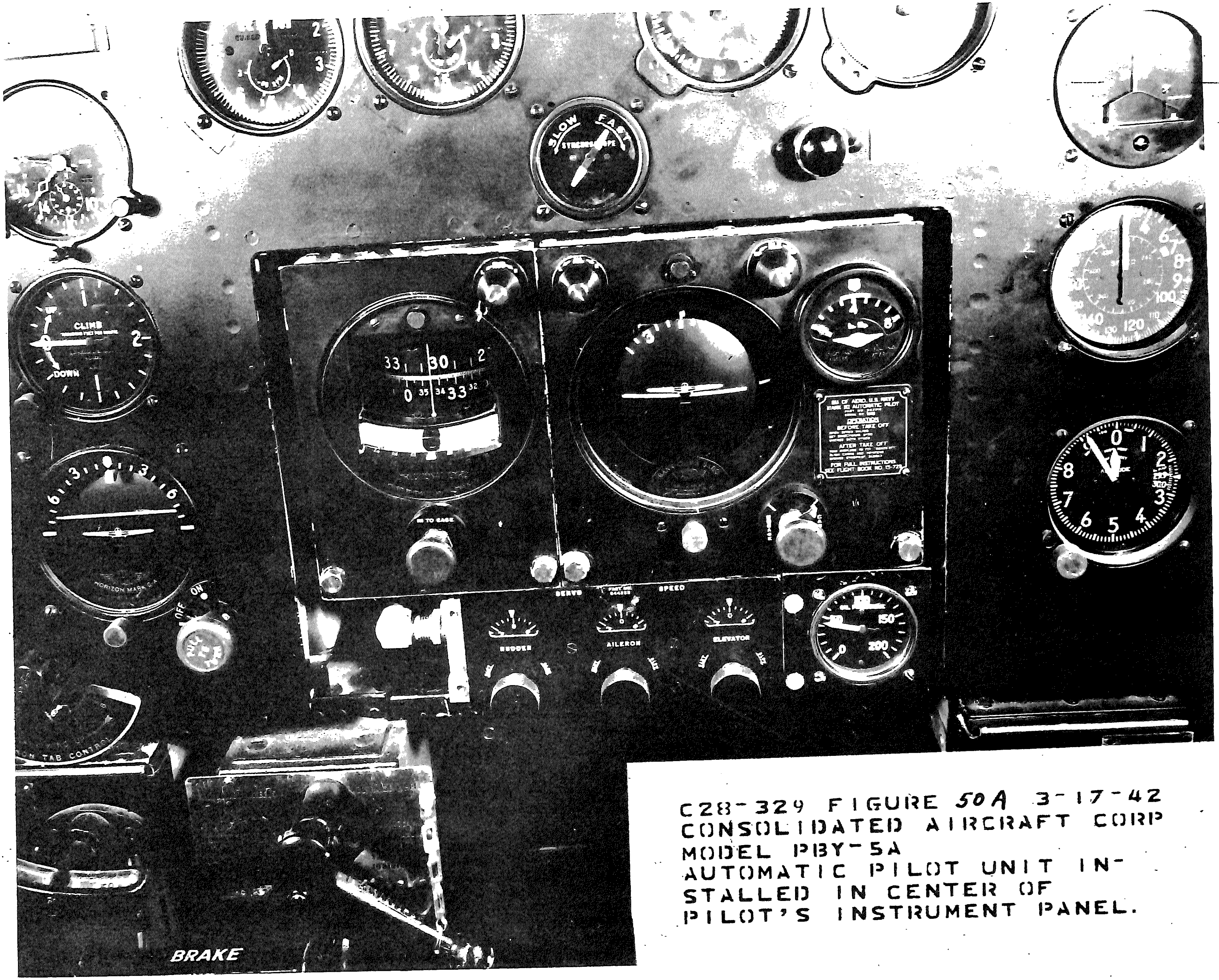
Astro-Compass

3. Miscellaneous Instruments

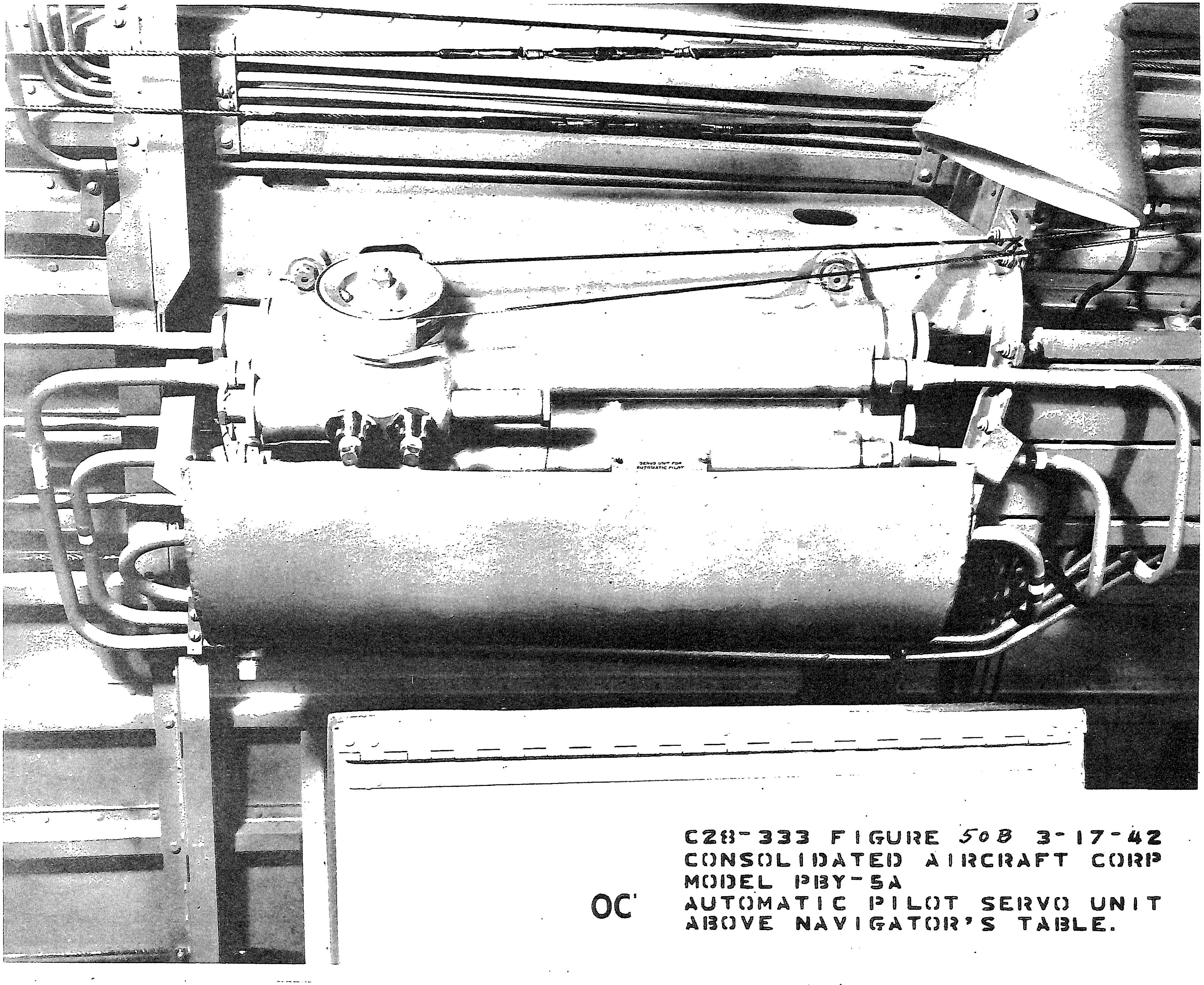
A clock has been installed on the aft end of the radio operator's table.

A box is provided on the aft face of bulkhead #2, immediately adjacent to the pilot's port rear window for mounting a Mark IX compass. The tabs which are installed on the back of the box slide in guides which are fastened to the bulkhead thus making the unit readily removable. Similar guides are provided on the aft face of bulkhead #6 above the door to permit the navigator to move the compass to this location when taking sights from the rear hatches.

The Astrograph hangs from the ceiling over the navigator's table and the Astro-Compass is stowed near the aft end of the navigator's table.



C28-329 FIGURE 50A 3-17-42
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A
AUTOMATIC PILOT UNIT INSTALLED IN CENTER OF
PILOT'S INSTRUMENT PANEL.



C28-333 FIGURE 50B 3-17-42
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A
AUTOMATIC PILOT SERVO UNIT
ABOVE NAVIGATOR'S TABLE.

OC

## I. Retractable Wing Tip Floats

### 1. Description (Ref. C.A.C. Dwg. 28L001)

#### a. General

This airplane incorporates retractable wing tip floats for cleanliness of design. A view of the float lowered is shown on Figure 51 . The floats may be operated electrically or manually. Manual operation is accomplished by rotating a crank. The crank is located at the engineer's station. The operating mechanism has two speeds. The selection of speed should be based upon the load on the crank. Electrical operation is accomplished by a motor driving the mechanism. The motor control switch is located at the engineer's station, forward of the observation window.

#### b. Retracting Mechanism (Ref. Figures 55 and 56 )

The hand crank, or the electric motor, operating through a gear train on the front face of bulkhead #4 turns a vertical shaft which connects to a three-way gear box on the front spar of the wing center section at the airplane centerline. This tube has a joint at the junction of the wing and the hull superstructure to facilitate removal of the wing. From the three-way gear box, torque tubes extend along the front spar each way to gear boxes near each wing tip. The tubes have sliding joints to overcome wing expansion. From each wing tip gear box a short tube extends aft to operate the locking and recoil mechanism, and through it to actuate the float retracting mechanism.

The retracting mechanism consists of a trunnion which is driven inboard and outboard on the main float retracting screw. The motion of the trunnion actuates the strut linkage system which raises and lowers the floats.

#### c. Locking Mechanism (Ref. Figure 53 )

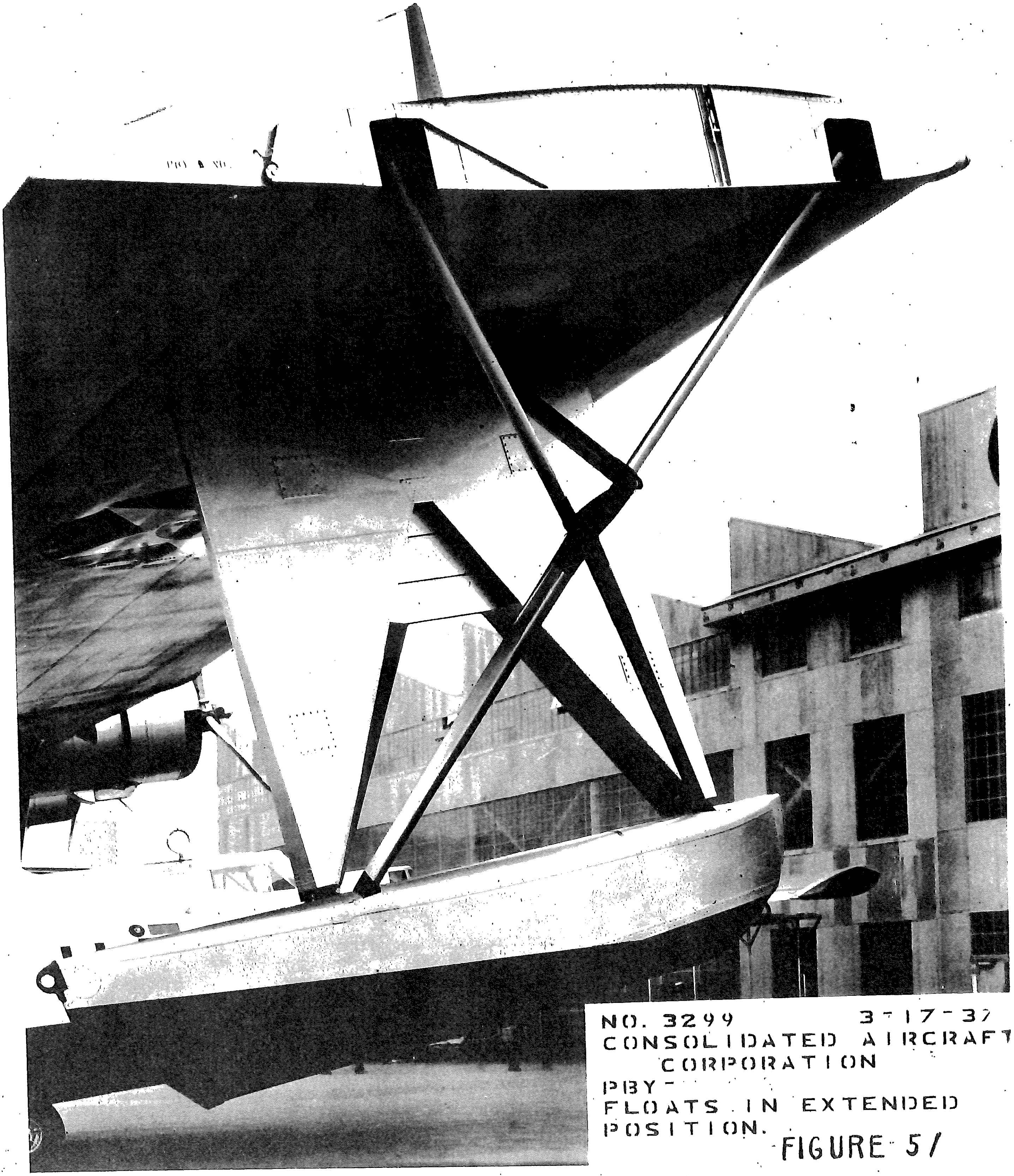
The locking mechanism consists of spring-loaded pawls which engage with the floats and the recoil mechanism.

Two rubber, bumper pads in each wing tip limit the upwar travel of the floats. They should be adjusted so as to prevent the float brace from recessing inside the wing contour.

The pawls are engaged automatically when the floats are fully retracted. The pawls are released automatically, before they start to drop, by cables which are pulled by a mechanism near the driving end of the screw.

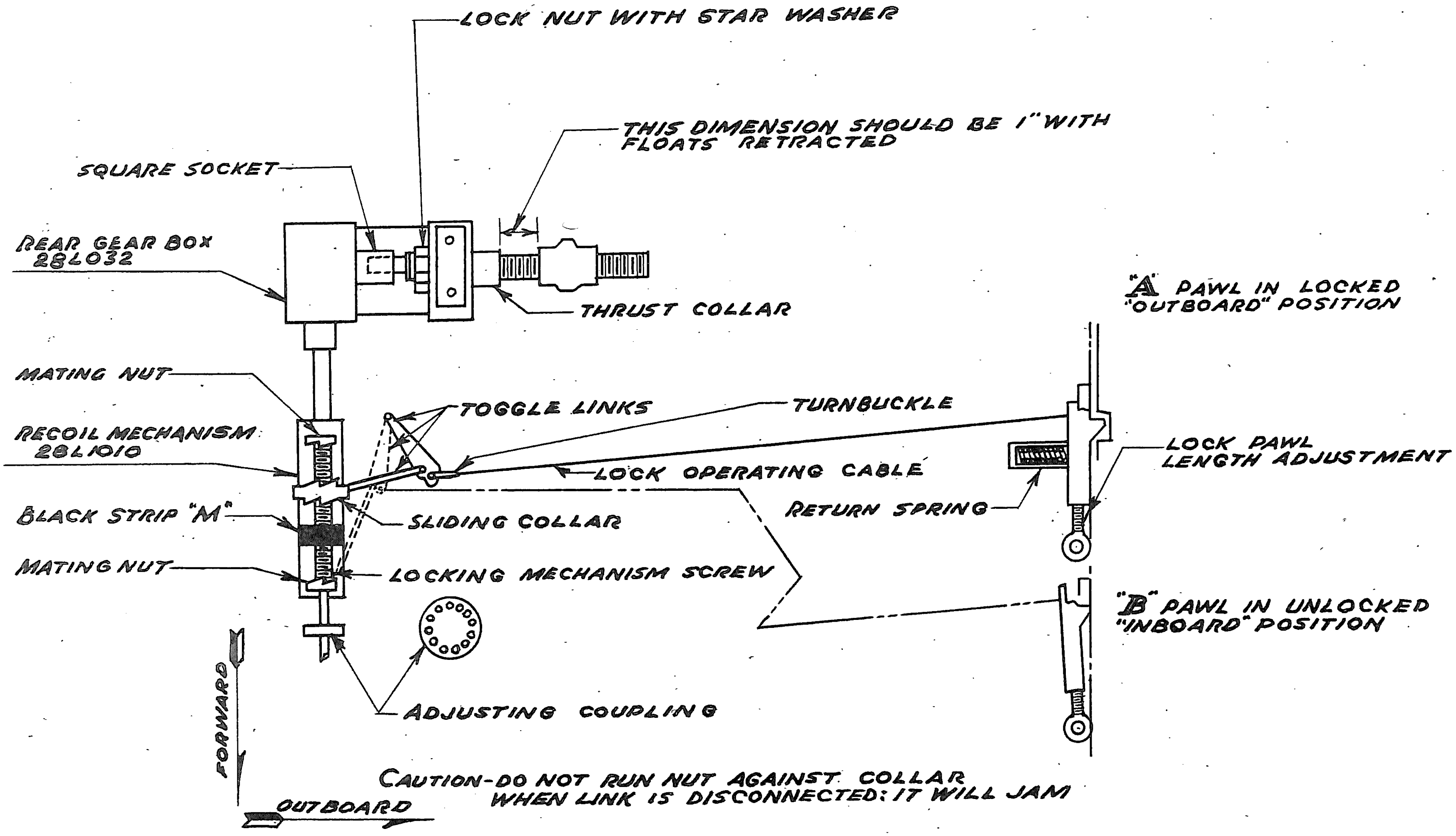
#### d. Locking and Recoil Mechanism (Ref. Figure 53 )

The inboard end of the pawl operating cable is attached to a toggle linkage. With the toggle links folded the cable is slack and the pawl is kept in its outboard position by a spring,



NO. 3299 3-17-37
CONSOLIDATED AIRCRAFT
CORPORATION
PBY-
FLOATS IN EXTENDED
POSITION.

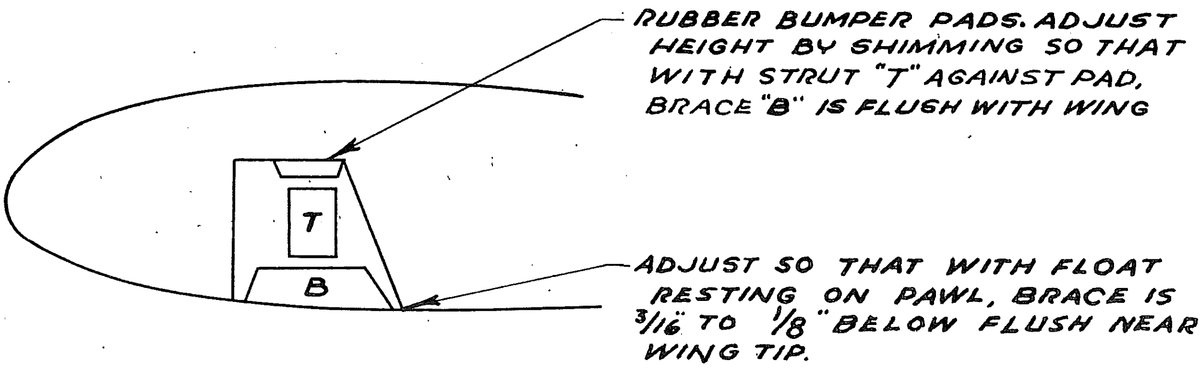
FIGURE 51



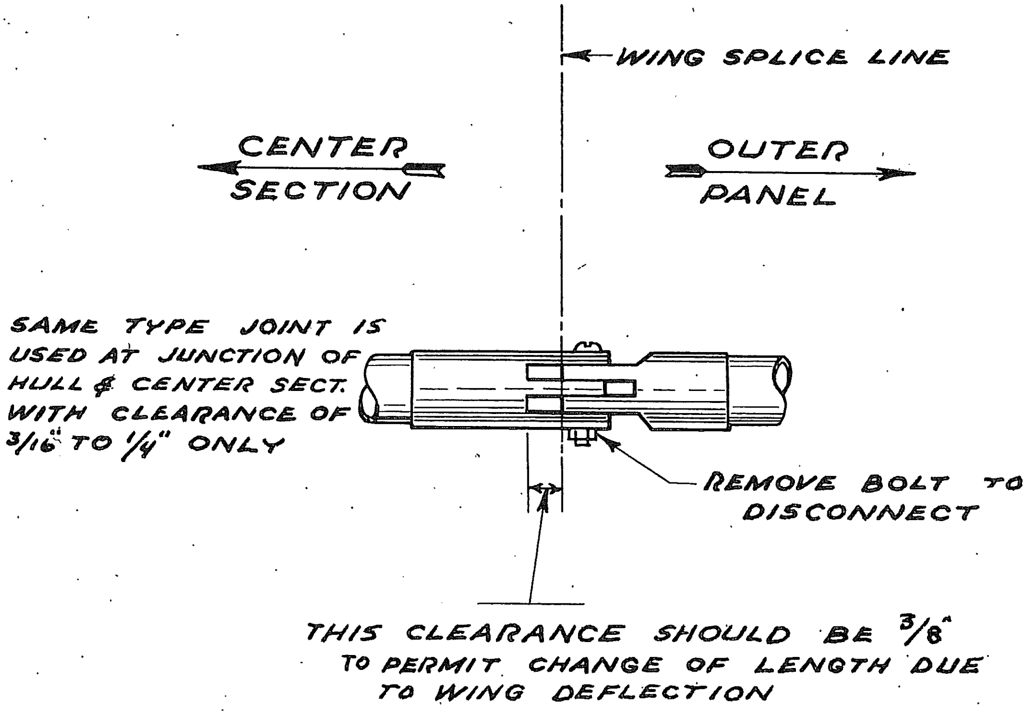
CAUTION-DO NOT RUN NUT AGAINST COLLAR
WHEN LINK IS DISCONNECTED: IT WILL JAM

REFER TO C.A.C. DWG'S.
28L006 & 28L1040

FIGURE 53
FLOAT LOCK & RECOIL MECHANISM


RUBBER BUMPER PADS. ADJUST HEIGHT BY SHIMMING SO THAT WITH STRUT "T" AGAINST PAD, BRACE "B" IS FLUSH WITH WING
T
B
ADJUST SO THAT WITH FLOAT RESTING ON PAWL, BRACE IS 3/16 TO 1/8" BELOW FLUSH NEAR WING TIP.

BUMPER PAD ADJUSTMENT


WING SPLICE LINE
CENTER SECTION
OUTER PANEL
SAME TYPE JOINT IS USED AT JUNCTION OF HULL & CENTER SECT. WITH CLEARANCE OF 3/16" TO 1/4" ONLY
REMOVE BOLT TO DISCONNECT
THIS CLEARANCE SHOULD BE 3/8" TO PERMIT CHANGE OF LENGTH DUE TO WING DEFLECTION

DRIVE SHAFT JOINT

REFER TO C.A.C. DWG. 28L001

FIGURE 54

FLOAT BUMPER AND DRIVE SHAFT

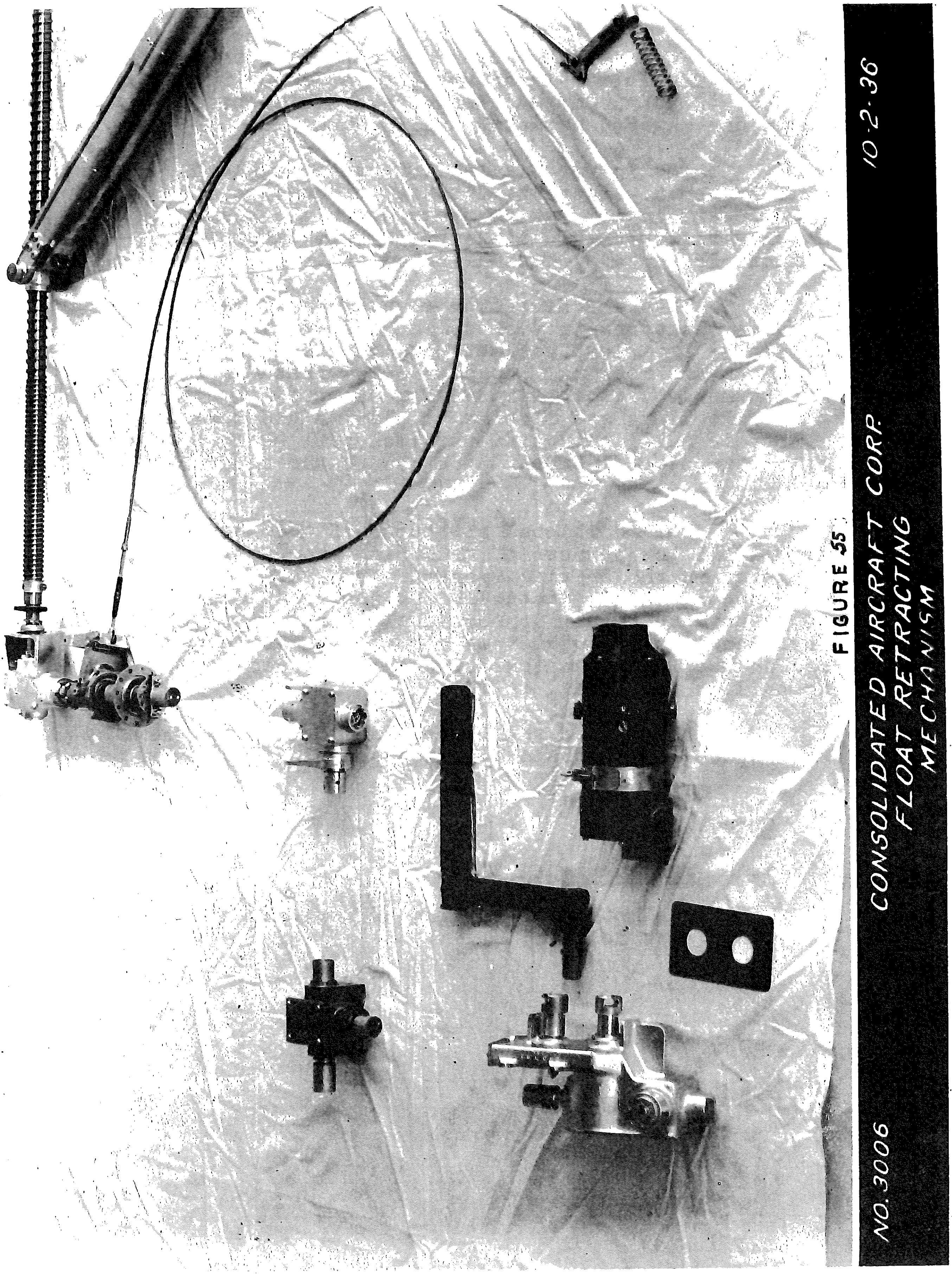

CONSOLIDATED AIRCRAFT CORP.
FLOAT RETRACTING
MECHANISM
NO. 3006
10-2-36

FIGURE 55

"A" on Figure 53. With the toggle links straight the pawl is pulled inboard to position "B" on Figure 53. One of the toggle links is attached to the wing structure, while the other travels with a sliding collar. The collar is attached to a traveling nut on the recoil mechanism. This nut moves along the short threaded recoil mechanism screw and engages a mating nut at each end.

The forward mating nut can be engaged only when the crank is turned to lower the floats. Before the traveling nut reaches the forward mating nut, through which the operating screw is positively driven, the toggle links straighten sufficiently to release the float lock pawls, thus allowing the float to be lowered.

When the direction of turning is reversed, the first six turns (11 turns in "low speed") of the locking mechanism is idle as far as the float retracting mechanism is concerned. The traveling nut on the locking mechanism screw must first travel to the aft mating nut, to establish driving contact. During this travel the toggle links are closing to slacken the lock pawl cable. When the float is fully retracted the lock pawl will automatically lock the float in place. Rubber pads absorb the shock of the raising float.

The additional six turns of the locking mechanism screw also fulfill the purpose of absorbing the recoil due to stored-up energy in the driving system. Thus, after the pawls are engaged, the recoil cannot disengage the pawls because the traveling nut would have to travel approximately three turns forward along the locking mechanism screw and cover the black strip painted on the outside of the locking mechanism drive cylinder before the cables tauten and pull on the pawls.

The floats are locked in the down position by the folding Vee struts which attain a locked position just past dead center.

## 2. Operation

### a. Instructions

The method of raising or lowering of the floats is as follows:

(1). Depress the knob on the end of the operating handle to unlatch the handle.

(2). Move the handle as far as it will go in the direction of the float motion desired.

(3). Hold the handle at its limit of travel for three seconds, and return it to the mid-position and latch it fast. It is important that the handle be held for three seconds for the reasons set forth below.

To reverse the direction of float travel, follow the same procedure as given in (1), (2) and (3) above.

To stop the floats between full "UP" or "DOWN" positions, proceed as follows:

(1). Unlatch the handle.

(2). Move the handle in the direction opposite to the float motion, to the point on the handle bracket marked "STOP".

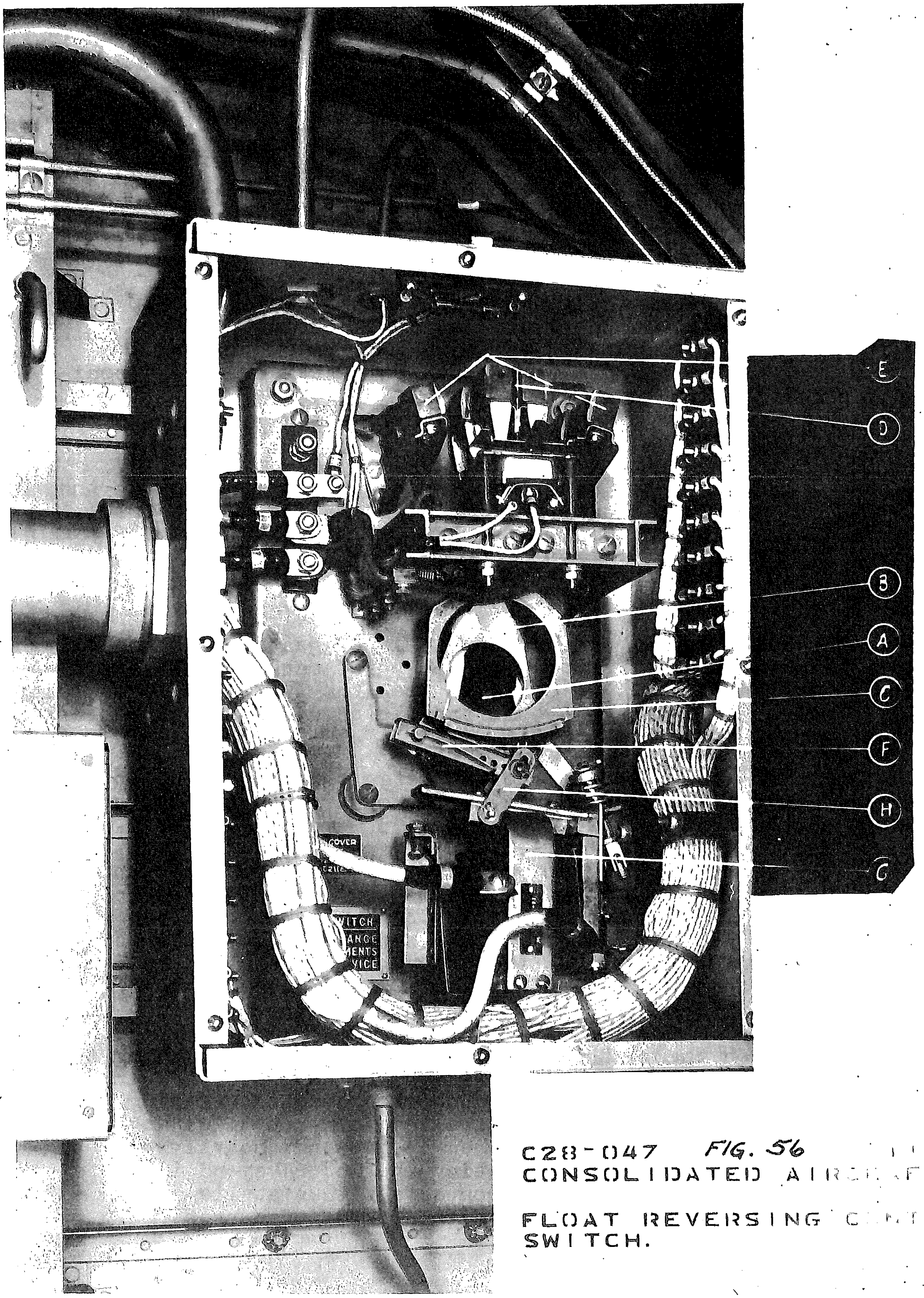
(3). Return the handle to the mid-position and latch it fast.

As a safety precaution, it is suggested that the switch handle be moved through neutral to the point marked "OFF", at the end of the float travel, in order to open the switch if it accidentally remains open. Normally, no trouble should be expected from switch operation failure.

For operation of the automatic trip on the hoist motor reversing switch, the engineer's handle must be in its mid-position so that sectors "B" and "C", of Figure 53 are free to move.

Should an operator be uncertain as to whether the floats are locked "UP", move the switch to "UP". If the floats are already full "UP", the automatic trip will not open the switch because latch "F", on Figure 53, is disengaged from sector "C", and will remain so as long as the contacts are held closed by the operator. This is the reason why the contacts must be held closed manually at the terminal positions of the floats.

When the switch is opened by the operator moving the handle back to the mid-position, switch contacts will arc and burn due to relative slowness of this mode of operation. During the time the switch is closed with a stalled (non-rotating) motor, a current of approximately 450 amperes is flowing, heavily discharging the batteries and rapidly heating the motor beyond its safe temperature limit. Closing the contacts with a stalled motor will cause it to burn out after about five seconds of current flow.



C28-047 *FIG. 56* [illegible]
CONSOLIDATED AIRCRAFT CO

FLOAT REVERSING CONTROL
SWITCH.

With properly adjusted relay, "G", the floats will always lock up. If a check is desired, the hand crank should be used to eliminate possible damage.

### b. Limitations of Use

The equipment described above has been designed to operate in a definite manner. It cannot be emphasized too strongly that airplane operators appreciate the limitations to which it is subject.

The power supply system, for the floats, is not designed for shore operation. Neither is the current value of the relay setting, given above, suitable for shore operation. The current value required to lift floats while ashore is considerably higher than in flight, so that floats cannot be expected to operate satisfactorily electrically, with the airplane beached.

### c. Operation of Electrical Controls (See Figures 54 & 56)

The engineer's operating handle, attached by pulleys, and a cable to the switch operating shaft, moves a steel finger, "A", to engage flanges of: first, reversing sector, "B"; and second, contact sector, "C". Sector "C", is rigidly attached to the motor contacts, "D", and moves them against the battery contacts, "E", but sector "B", moves freely when finger "A" is removed from contact with it.

When contacts close, latch "F", is pulled down away from engagement with the sectors, "B" and "C", coincident with the starting of the motor. This action is caused by relay, "G" which is connected into the hoist-motor circuit and which is set to operate at a pre-determined current of approximately 275 amperes. The engineer, therefore, must hold the switch closed with the handle; otherwise the contacts will open under the spring pressure if the hand is removed, while the latch is drawn down by the relay.

As the motor accelerates, requiring approximately 3 seconds due to the reduction of the loads on the floats, the latch "F" is released by relay "G" and engages an undercut edge on sector, "C" thus holding the switch contacts closed. The switch contacts will now remain closed until the float-retracting screw trunnions strike the stop on the outboard ends of the screws. At this instant the motor ceases to rotate, causing a current inrush in excess of the relay setting to flow through the motor and the relay, so that the relay operates, disengaging latch "F" and sector "C" and allowing spring pressure to force the contacts open.

When the engineer opens the switch manually by moving the handle to "STOP", latch "F", is forced down by the edge of the sector "B" which is moved by finger "A", so that the latch and sector "C" disengage. In this case, the relay "G" does not operate electrically.

## 3. Maintenance and Inspection

### a. General

To insure an easy and smooth-running condition of the float mechanism, inspection of all its component parts should be made at overhaul periods.

Periodic servicing the floats and mechanism consists of lubricating and checking to ascertain the physical condition of the system. Access to the system is through inspection doors provided in the leading edge of the wing and through removing the superstructure fairing. See Figure 13 . Access to the outboard system is gained by lowering the floats to the landing condition.

All torque tubes must rotate freely and easily. Bearings should be inspected for breaks and grit. Gears must be in smooth-running condition. Sliding joint connections and universal joints must be replaced if wear becomees excessive. Check for simultaneous operation of floats as described above. Replace all broken or worn parts. See C.A.C. Drawing 28L001 for longitudinal clearance at sliding joints (hull to wing and outer to center wing panel joints).

### b. Checking for Friction and Binding

A simple way to check the system for excessive friction is given below. Do not try this in a strong wind as it will influence the crank loads depending upon the direction of the wind.

(1). Place the floats in full "DOWN" position.

(2). Start turning low speed crank toward "UP" positions for 10 or 11 turns. Operating screws will not be moved due to the idle turns in the recoil mechanism. Thus, during these turns, only three gear boxes and all torque tubes are operating. Therefore, the load on the 8" low speed crank should not be more than 3 to 5 pounds.

(3). When cranking beyond 10 turns in the "UP" direction, the screws will be turning, but because of the dead point of the struts, no great additional load should be felt on the crank for approximately 20 turns. After the tenth or eleventh turn, the load on the crank will not exceed 4 - 6 pounds, if the system is operating correctly.

(4). Change to "HIGH" speed drive and crank "UP" until the load becomes heavy. Then switch back to "LO" speed to finish retracting the floats. The crank load near the top should not exceed a total of 25 to 30 pounds. If excess crank load occurs at this point, check for the following causes:

(a). Interference: In this case, the crank load would increase suddenly. Stop where increase in load is felt and check for interference, especially near the tip of the wing.

(b). Distortion: The influence of distortion or misfit is negligible near the dead point of the struts, full "DOWN". Toward the folded position, it becomes increasingly noticeable. Distortion may be caused by bent or damaged parts, or fittings having become misaligned due to excessive loads. To check for such a condition, disconnect one float link at the Vee strut and recheck the system for one side alone. Thus, it can be established which side is giving trouble. Then check the faulty side, with the link disconnected, by moving it up and down by hand.

(c). If an intermittent jarring load occurs, especially when the motion of the floats is downward, the cause may be one of several. The ends of the operating screws may have become loose. The screw may need lubrication or too heavy a lubricant may have been used. Check the lubrication diagram, Figure . A coating of sand or dirt on the screw will also prevent smooth operation.

c. Electrical System

In addition to insuring that all mechanical and electrical connections are tight, a periodic check of the motor, switch, and cable connections should be made. It is recommended that these be checked after every 30 hours of flying time.

d. Retracting Motor

The motor should be cared for in accordance with instructions given in Eclipse Aviation Corporations "Instructions for Aviation Generators and Starter Motors".

e. Switch

The most important elements of the switch assembly are: Contacts "D" and "E" and relay "G" on Figure 56 . Contacts "D" are carried on steel leaf springs which maintain pressure required on contact faces and hold them in proper alignment. All soldered connections in the switch are made with silver solder to give the best conductivity characteristics, both electrical and thermal. Contacts are copper blocks to which are soldered facings of Mallory "Elkonite", grade G-17, a silver-molybdenum alloy. The facings have curved self-wiping surfaces.

The contact alignment may be checked by noting the polished appearance of these surfaces where the rolling and wiping actions take place. There should be a solid unbroken bar presenting such an appearance across the surface of each block. Should re-alignment become necessary, loosen the screws under the battery contacts "E" first removing safety wires, and shift blocks until desired "line" contact is obtained. A small slip of very thin paper moved between the surfaces will aid in determining if a full "line" contact has been made. Tighten the screws and replace the safety wire after adjustment.

Normally these contacts will require no attention other than an occasional cleaning, for which purpose heavy brown Kraft paper should be used. DO NOT USE SANDPAPER, EMERY CLOTH, OR FILES for cleaning contacts, since the wiping and rolling action required depend upon the curvature of the surfaces remaining unchanged. Note that small burns on the surfaces do not indicate poor contacts, as the silver oxide formed in these spots is a good conductor. DO NOT LUBRICATE.

Relay "G" on Figure 56 , is one type of electromagnet whose magnetic field exerts a pulling force upon its movable armature, to which the latch, "F" is attached by slotted links, "H". Slots "H" must be at the top of the links; these allow the relay to produce the impact force on "F" upon which the successful operation of the automatic trip device depends. Contacts between the links and the latch at sector interfaces should be sliding and should be lubricated when necessary with petrolatum or equivalent.

### f. Relay

Relay "G" on Figure 56 , must be adjusted with the airplane in normal flight. The floats should be operated by the flight engineer and the operation of the switch mechanism observed from in front of bulkhead #4.0. By means of the spring, "J" of the relay, adjustment should be made so that the floats will go all the way "UP" and lock before the relay is energized to open the switch. This adjustment should be checked by running the floats "DOWN".

Adjustment is critical for "UP" operation. When once accomplished, this adjustment will serve for correct "DOWN" operation as well. Only enough tension should be put in spring "J" to insure that the floats will lock after moving up. Too stiff a spring will result in an overheated motor and ultimate motor failure.

### g. Cable Connections

Cable connections must be kept taut and so adjusted that finger "A" on Figure 55 , is on vertical center when the flight engineer's handle is latched in mid-position. Adjustments for position may be made by means of the two turnbuckles on the cables, loosening one and tightening the other an equal amount.

### 4. Indicator System

An indicator system is connected to the switch by arm, "K", on Figure 55, which indicates by a red signal, on the pilot's and engineer's instrument panels, when the throttles close while the floats are retracted. This indicator system is inoperative when the floats have been raised by the hand crank. The fuse for the switch is in the float switch box. The automatic throttle warning switch is aft of the throttle, on the ceiling, forward of bulkhead #4.

### 5. Lubrication

Refer to the lubrication chart, Section VI for parts to be oiled. Gear Boxes are sealed and do not require regular lubrication. The retracting struts operate through a small angle at a limited speed and need only occasional greasing.

### 6. Synchronization of Float Drive (Ref. Figures 53 & 54)

When installing new floats or when replacing floats, the following procedure should be used to synchronize the drive:

a. The stop on the outboard end of the main float-retracting screw should be set so that its jaws engage 1/8" to 5/32" with the jaws of the trunnion. This adjustment is made before assembling the screws into the wing. Secure the locknut and lockwasher on the screw.

b. For convenience in assembling and checking, the following is adopted as the "timing position". With floats in full "DOWN" position, both trunnions on the float-retracting screws should be on the outboard end, engaged as per (a) above. See that no initial torque is put into the system by the crank at the engineer's station. Use the adjusting coupling just ahead of the recoil mechanism to obtain the desired relative position.

c. Turn the crank toward the full "DOWN" position until the timing position of "B" is reached, and check that the lock pawls at the wing tips are retracted (inboard).

d. Crank slowly (with slow-speed gear) approximately five to six turns toward "UP" until the sliding collar on the recoil mechanism reaches and covers the black strip painted on the outside of the locking-mechanism drive cylinder. The lock pawl at the wing tip should now have moved outboard to be ready for engagement position "A". The cable from the locking mechanism to the pawl should now be just barely taut.

e. Crank floats up by hand-crank until fully retracted. If necessary, adjust length of locking pawl so that both floats engage when the float braces are near the wing tips, approximately 1/8 to 3/16 inch below contour of wing. If both floats are in the position described, no further adjustment is necessary and cottering and safety wiring may be completed.

f. If one float is not adjusted as described in paragraph (e) above while the other float is correctly adjusted, disconnect the adjusting coupling near the locking mechanism on the side of the locked float. Continue cranking "UP" slowly from the engineer's crank until the other float is in the correct position, noting how many holes the loosened coupling slips. Reconnect the coupling.

g. By changing the coupling as per paragraph (f), the original timing position is changed, but it is more important that the floats synchronize correctly when retracted than when extended. If the above correction amounts to only one or two holes in the coupling, the difference is not objectionable, since in the down position, the trunnion and the stop will be only 1/4 to 3/8 inch from engaging, and no further adjustment will be necessary.

If more than one or two holes correction was necessary, it will be desirable to correct the stop as stated in paragraph (a). Lower the floats until on one side the mating nut is engaged with the trunnion jaws. Disconnect the retracting link at the connection with the Vee strut on the side on which the float was not correctly engaged. Push the Vee strut out to bring the link into the straight-hanging position to get it out of the way. Disconnect the outboard retracting screw bearing. Loosen the lock washer and lock nut on the screw end, and reset the stop to desired engagement. Twenty-four variations of this adjustment are possible and the best one should be selected. Return the link to its position and reconnect.

h. When rechecking the synchronization of the floats the controls are always to be operated in the "UP" direction. This procedure will insure that the recoil mechanism is always loaded by the weight of the floats and the free motion of the recoil mechanism is taken up. When the floats are lowered manually, with the airplane on the ground, one or both floats may lower in steps, giving the impression that the system is out of phase. This is due to the weight of the floats taking up the excess travel in the recoil mechanism at certain parts of the trunnion travel and is no indication of the operating condition of the system.

Occasionally check the float lock pawls for dirt or foreign matter which might prevent them from automatically engaging.

i. CAUTION

Before disconnecting the float drive at any point, place a brace or other support under the float. If it should become unlocked by chance while unsupported, it might extend by itself, unexpectedly causing a rapid rotation of the system, which might be dangerous to personnel.

## J. Hydraulic System (Ref. C.A.C. Dwg. 28F6500, Figure 57 )

### 1. General Description of Units

The main units of the hydraulic system are:

a. Engine Driven Pump
b. Hand Pump
c. Reservoir
d. Unloading Valve
e. Accumulators
f. Relief Valve
g. Check Valves
h. Return Valves
i. Selector Valve
j. Actuating Cylinders
k. Latch Releasing Cylinders
l. Sequence Valves
m. Power Brake Valve
n. Brake Deboosters
o. Filter
p. Pressure gage

The Engine-Driven Pump is a Gear, TWO G.P.M. (214-T) Pesco type, and is mounted on the outboard gun synchronizer drive of the starboard engine. The intake is connected to the reservoir by a cotton reinforced, 5/8" flexible tube. The pressure outlet is connected to the pressure line by means of a metal braid reinforced, 1/2" flexible tube.

The Hand Pump (Pesco #437-F) is located inboard of the co-pilot's seat where it is accessible to either pilot. The suction line of pump which connects to the aft end of pump connects directly with the reservoir. The line that connects to top of pump is the pressure line and it connects to main system just forward of the unloading valve. The hand pump is primarily used to operate landing gear up or down in cases of emergency or functional necessity.

The Reservoir is mounted on the R.H. side of the starboard nacelle just aft of the firewall. There are three lines connected to the reservoir. One is the return line from the main hydraulic system which connects to reservoir approximately 6" from the bottom, and at an angle which prevents vortexing of fluid. The second line connects to a fitting that goes to the engine-driven pump which is the pump's suction line. The third line is a suction line for the hand pump. The cap on top of the reservoir is vented and should be kept free of obstructions. In filling reservoir, follow directions on nameplate attached. Correct procedure for replenishing system with fluid will be found in section 2 following. (Fluid, A.C. 3580 or M-339 mineral oil).

The Vickers Unloading Valve (AA.14506) maintains a constant pressure in hydraulic system of 800 to 1000 p.s.i. It operates in conjunction with the accumulators which are necessary for

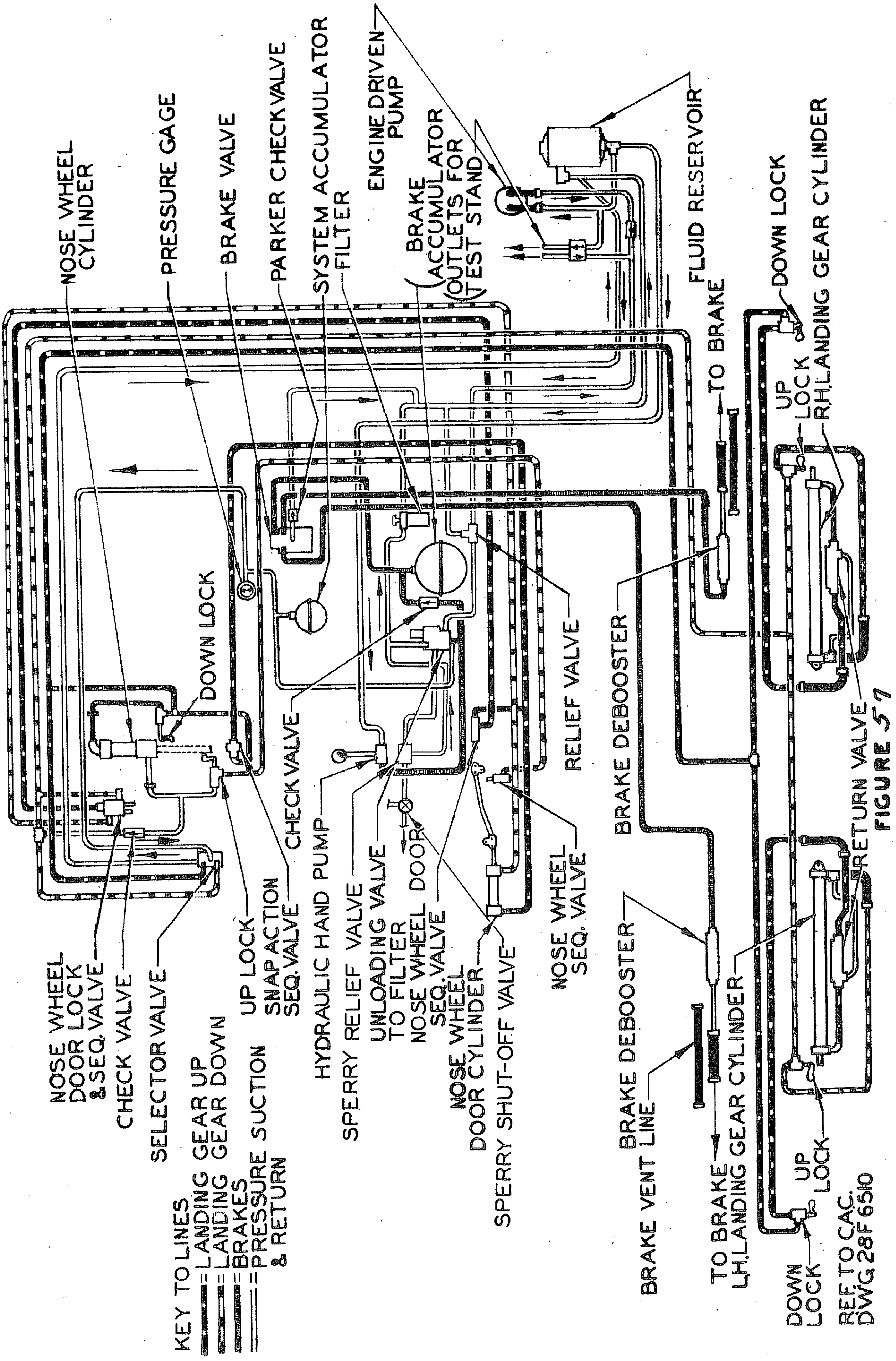


FIGURE 57

HYDRAULIC SYSTEM DIAGRAM

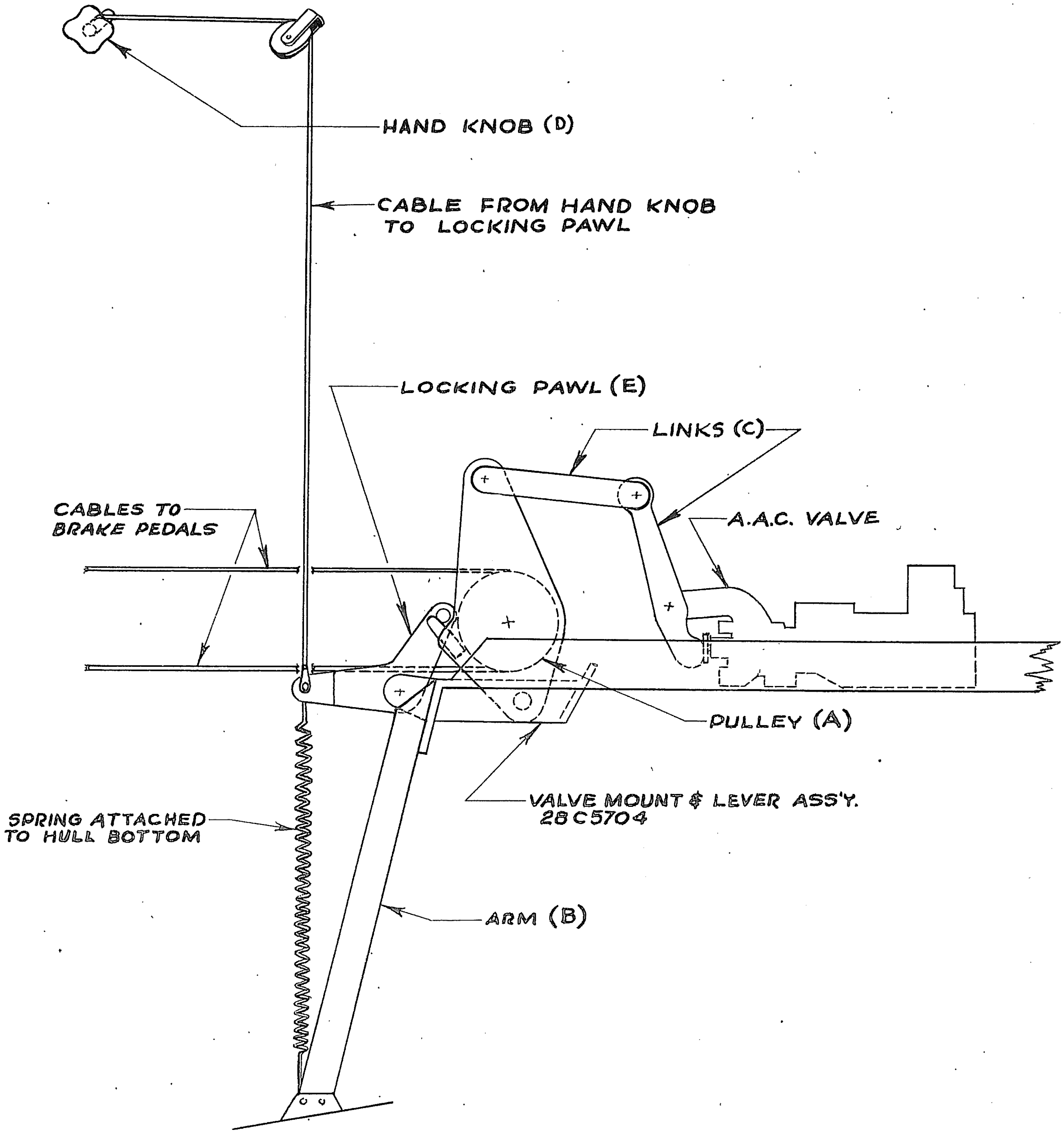
b; The Snap Action sequence valve is located on the starboard side of the auxiliary keel just below the co-pilot's left control pedal. Its operation in relation to the hydraulic system is to function at a desired interval and at the exact time the nose gear is up and locked. This valve is operated when it is engaged with the bellcrank attached to the torque arm of the nose gear. The forward port on this valve connects with the nose door cylinder up line. The aft port connects with the up line of the selector valve. Its operation provides pressure to the nose door cylinder.

c. The Door Lock and Sequence Valve is located in the bilge just forward of the bulkhead #1. This valve is a combination actuating cylinder and sequence valve. The starboard side of the valve is the actuating cylinder side and is connected to the door locking pins. The port side is the sequence side of the valve and is operated by the mechanism attached to opposite side of the valve. The actuating side of the valve is evident. It merely locks or unlocks the nose doors. The sequence side of the valve controls the timing of operation of the nose door to the open position, and operates only at the time when the door locking pins have unlocked the nose doors. All sequence valves in this hydraulic system are adjustable. The proper setting and adjustment of these valves will be found in Section 2 following.

The Power Brake Valve (A.A.C. 36020A) is a right and left brake built into one integral unit, and is located between bulkheads #1 and #2 starboard of the co-pilot's right control pedal. It is operated by either pilot or co-pilot and is connected to the dual brake pedals by means of a parallel linkage and cable system. Pressure to operate the valve is supplied by the 10" accumulator and connects with the pressure inlet port, which is the port farthest starboard. The return line of brake valve is located in the center and on top of the valve. The brake pressure (3/8") lines are located at the forward and aft ports of the valve.

The brake valve is adjustable and is set for a mximum pressure of 600 p.s.i. at the factory. To operate parking brakes, a locking pawl is held clear of the arm and linkage by means of a spring attached to the hull bottom. By turning the parking brake knob (located just below and to the right of the co-pilot's instrument panel), this pawl may be pulled down so that it engages and locks the arm and linkage in the "brake on" position. It is necessary to have the brake "ON" before the pawl engages the arm. When it is desired to release the brakes, pressure on the brake pedals will move the arm and linkage enough to disengage the locking pawl, which will be pulled into its inoperative position by its spring. Refer to Figure 58.

The Brake Deboosters (#A.A.C. 36021), sometimes called Power Brake Master Cylinders, are located just forward of bulkhead #4 on the hull bottom. Caution must be exercised in the installation of these cylinders that the high pressure side always points outboard. The high pressure side of the deboosters can always be ascertained by noting breather holes in the high pressure end. There are two deboosters per airplane, one for each wheel brake.


HAND KNOB (D)
CABLE FROM HAND KNOB TO LOCKING PAWL
LOCKING PAWL (E)
LINKS (C)
CABLES TO BRAKE PEDALS
A.A.C. VALVE
PULLEY (A)
VALVE MOUNT & LEVER ASS'Y. 28C5704
SPRING ATTACHED TO HULL BOTTOM
ARM (B)

REFER TO C.A.C. DWG. 28C5708

FIGURE 58
BRAKE VALVE & BRAKE LOCK MECHANISM

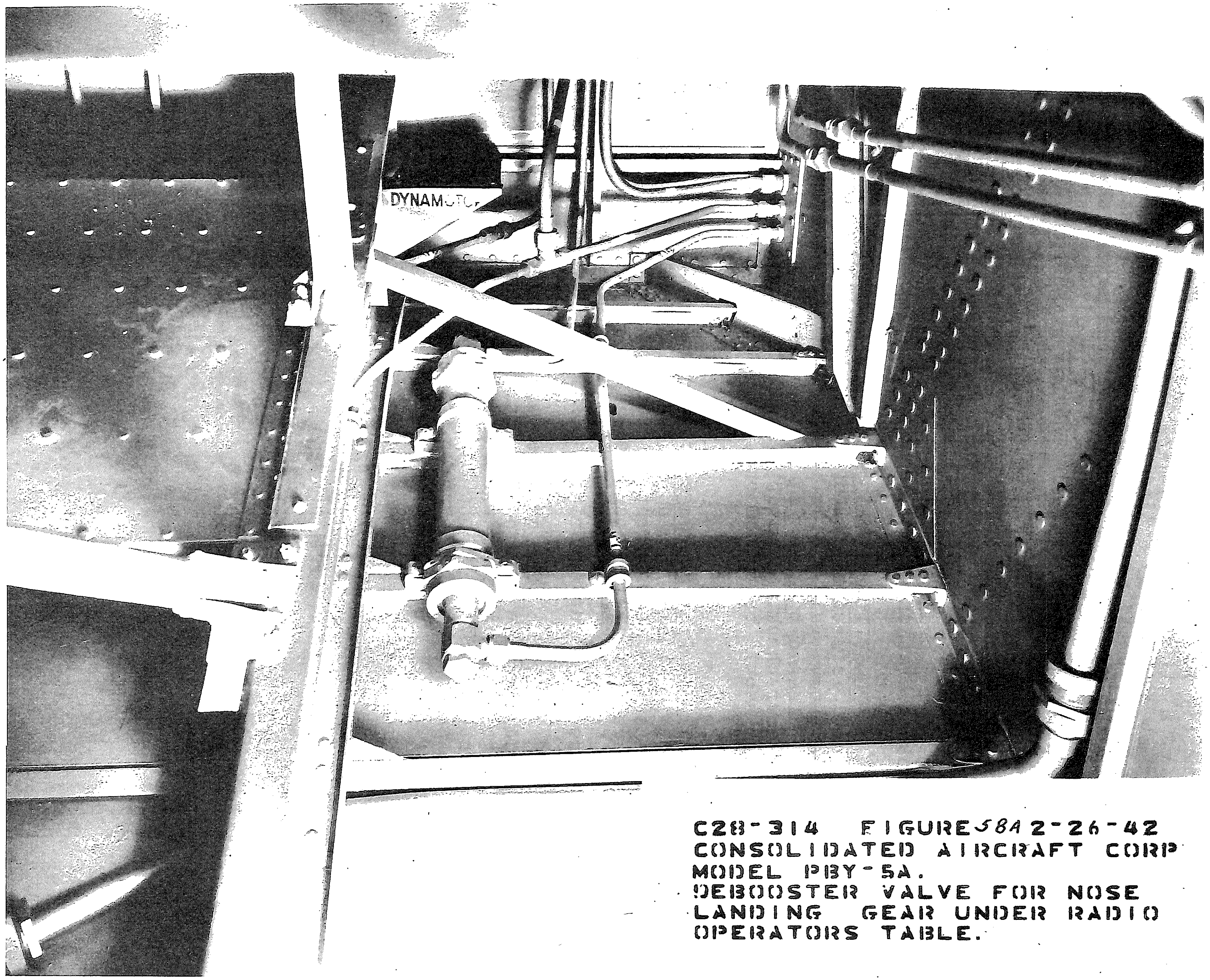
The outboard port of these deboosters, (high pressure side) connects directly with brake valve. The starboard and port sides connect directly with the wheel brake. These deboosters essentially consist of a steel cylinder barrel fitted with a spring-loaded piston that divides the cylinder into two pressure chambers - a high pressure, small volume chamber and a low pressure, large volume chamber. The latter chamber is approximately three times the area of the high pressure chamber, which gives a usable operating pressure for the wheel brakes. The low pressure side acts as a "deboosting agent" inasmuch as it removes the amount of oil used to operate the brakes back into the low pressure chamber of the debooster. A compensating check valve located in the lower end of the high pressure side automatically supplies fluid dissipated by leakage anywhere in the wheel brake system and also provides for bleeding of the brakes. The feel of the brakes depends largely on the smooth operation of the deboosters.

The Filter (Cuno #11279) is located on the hydraulic platform and is used to filter all foreign material out of the hydraulic system. This filter is of plate type construction'and should be cleaned by draining the sump at bottom of filter at every 60-hour check. A movable handle is located at the top of the filter and should be turned one complete revolution before each flight.

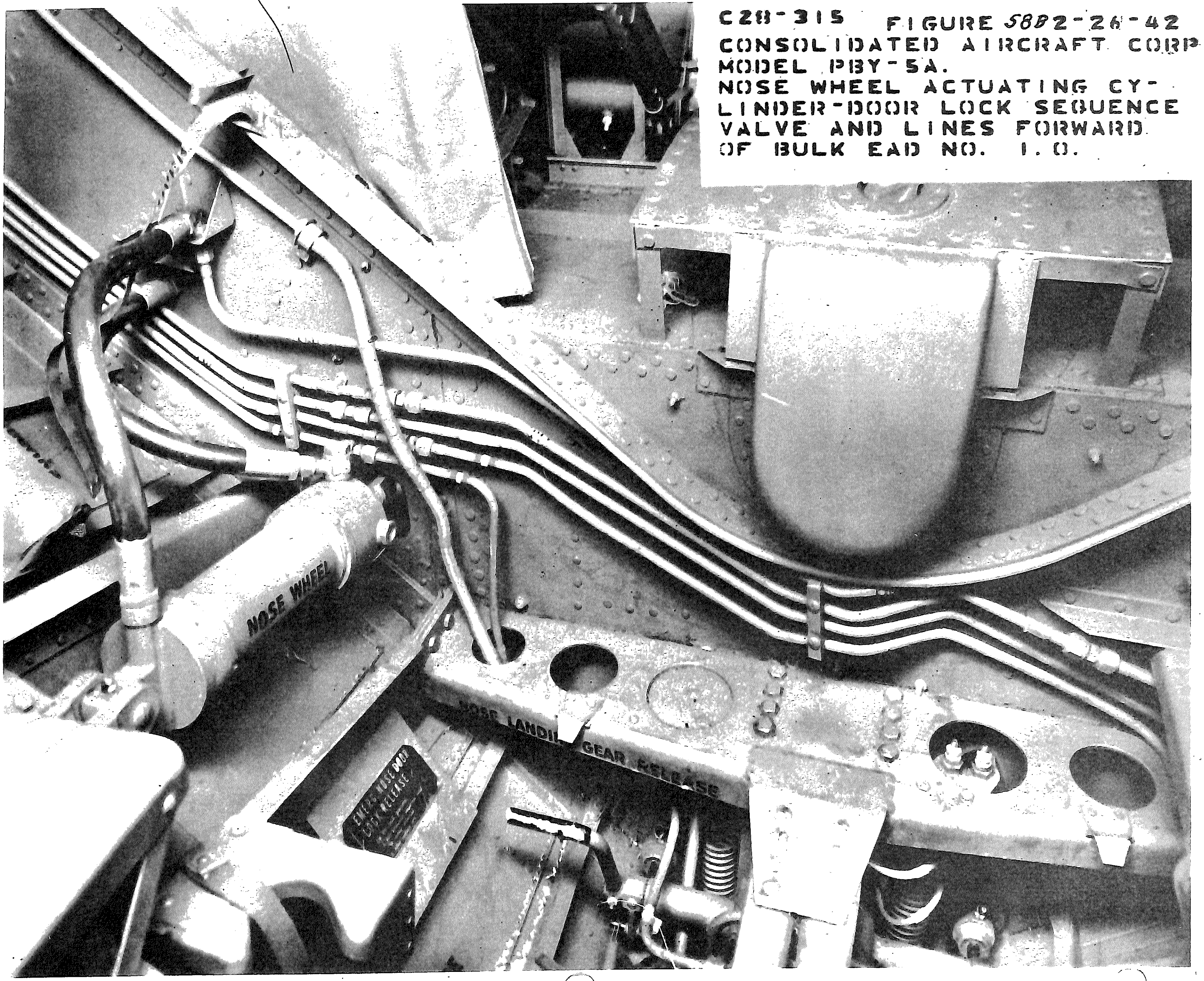
The Pressure Gage is located on the instrument panel on the co-pilot's side. It indicates the system pressure at all times. This gage should be read between 800 and 1000 p.s.i. when hydraulic system is being operated. This gage does not indicate pressure in the brake system or 10" accumulator. It is connected to the pressure line entering the selector valve.

Surges: The selector valve return line teeing into the unloading valve return line introduces sudden surges on the landing gear up line when the unloading valve is in operation. To prevent this surge on the landing gear up line, the return line from the selector valve has been connected directly to the reservoir.

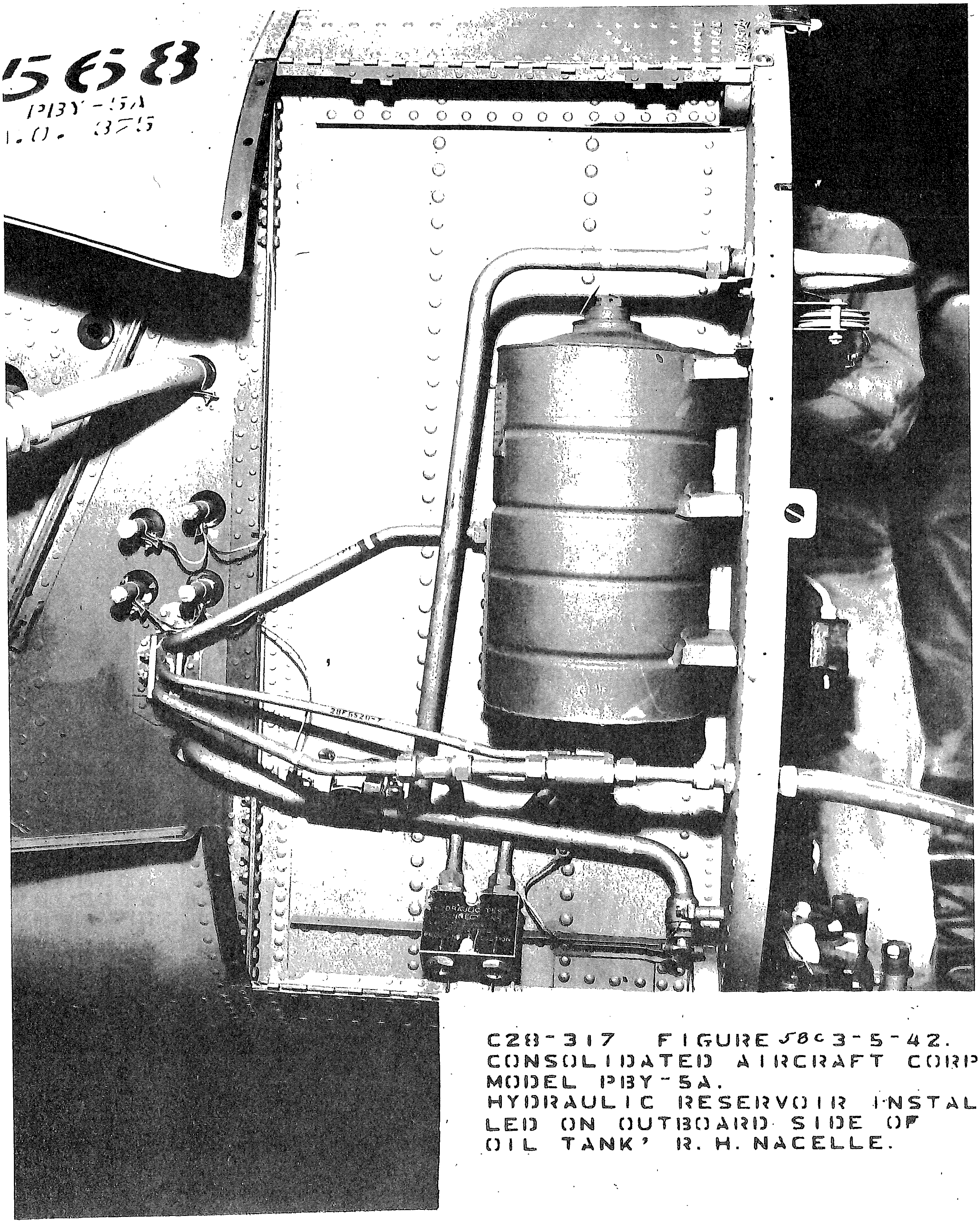
Revised 4/1/42
C.A.C.



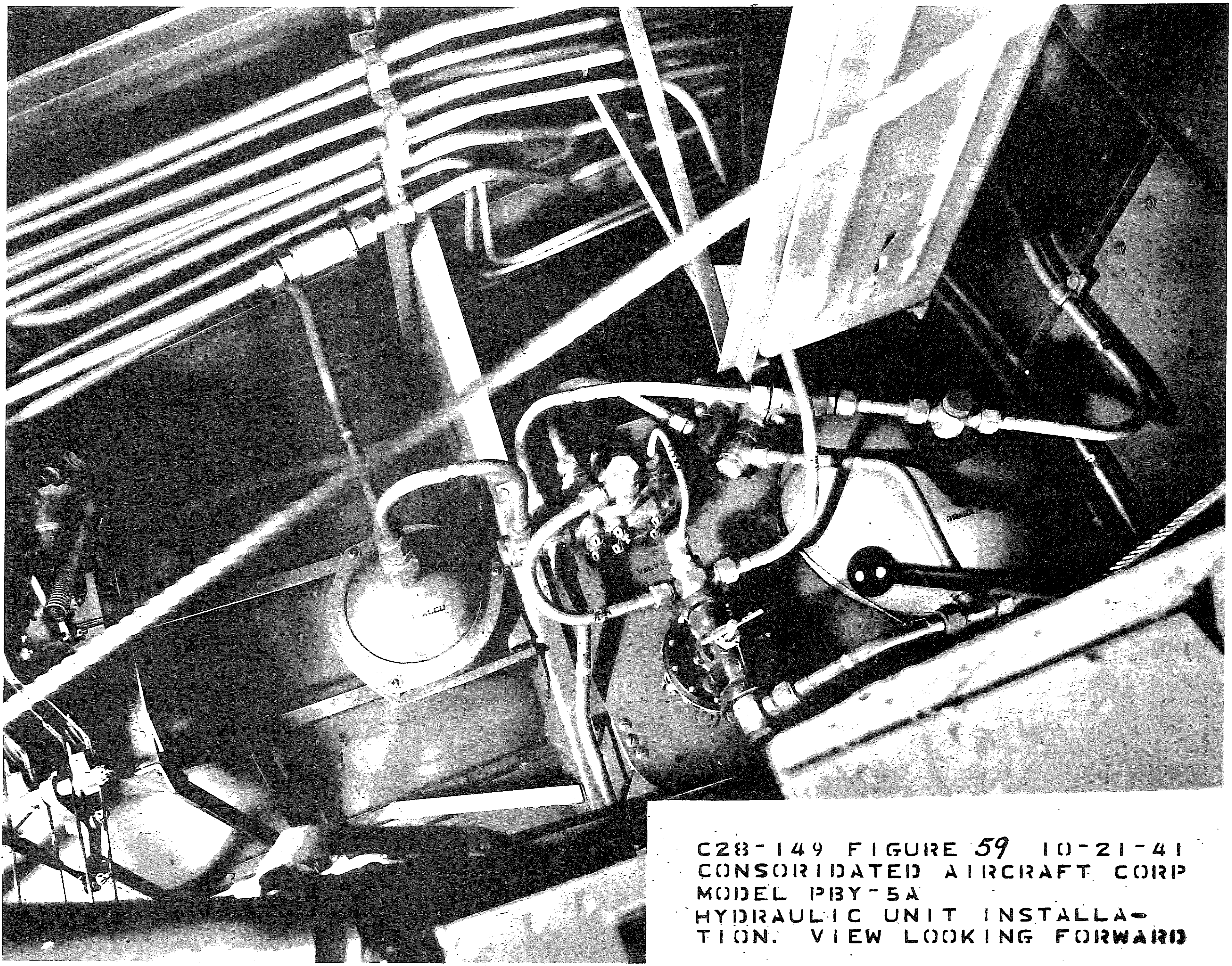
C28-314 FIGURE 5BA 2-26-42
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A.
DEBOOSTER VALVE FOR NOSE
LANDING GEAR UNDER RADIO
OPERATORS TABLE.



C28-315 FIGURE 5882-26-42
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A.
NOSE WHEEL ACTUATING CYLINDER-DOOR LOCK SEQUENCE
VALVE AND LINES FORWARD
OF BULK EAD NO. 1.0.



C28-317 FIGURE 58c 3-5-42.
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A.
HYDRAULIC RESERVOIR INSTALLED ON OUTBOARD SIDE OF OIL TANK' R. H. NACELLE.



C28-149 FIGURE 59 10-21-41
CONSORIDATED AIRCRAFT CORP
MODEL PBY-5A
HYDRAULIC UNIT INSTALLA-
TION. VIEW LOOKING FORWARD

## 2. Service and Maintenance

### a. Filling Hydraulic System

The airplane must be jacked up or on its Beaching Gear with main wheels removed.

After all adjustments of sequence valves, unlatching jacks, actuating cylinders, have been made proceed as follows:

(1) The accumulators should be filled with 600# p.s.i. of air. All oil in upper half of accumulator should be removed before filling with air. Connect air bottle or booster pump to air valve at bottom of 5" accumulator. If hydraulic pressure gage shows pressure in system, move selector valve handle to up and down positions until pressure gage reads "0" pressure. Now fill 5" accumulator with 600# p.s.i. of air. Watch pressure gage to see if pressure is created in system while filling 5" accumulator. If gage starts to raise, keep moving selector valve handle until all pressure has been dissipated and 5" accumulator has been completely charged with air.

The filling of the 10" accumulator can be accomplished two ways. First, the oil can be removed from top of 10" accumulator by constant operation of brakes, which require 10 to 15 minutes of operation in conjunction with filling accumulator with air. Second, a surer but less convenient way to ascertain if oil is still in upper half of accumulator is to disconnect line on top of accumulator. This will relieve all oil under pressure. Fill with air to 600# p.s.i. In cases where one common air valve fills both accumulators, above procedure should be followed simultaneously. If for any reason the air has to be removed from either accumulator the valve core should be replaced with standard air core valves. (Schrader #1939 or Dill #100-DBB). Caution should be exercised not to insert ordinary tire valves.

(2) Connect test stand to test block located under reservoir in R.H. engine nacelle. (Caution - use type hose specified on nameplate located on test block. The check valves in block will not operate if wrong hose is used). If test stand does not have a reservoir built into it, the reservoir in wing should be filled and a man should be stationed there to continue filling reservoir until system is completely full. It takes approximately 7 gallons of oil (A.C. 3580) to completely fill system. (Caution: if test stand is used, make sure hydraulic pump does not pump over 2 G.P.M.). If test stand is not available and starboard engine has to be started, reservoir will have to be filled as above.

Start motor and watch hydraulic gage. As system starts to fill with oil the gage will raise to 1000# p.s.i. reading, and the unloading valve will cut-out, which indicates accumulators have been charged with oil and system is ready to operate. Turn the selector valve handle into up position and operate through 1/2 of a cycle, then return handle to down position. Operate gear in this manner several times, then start operating gear through 10 to 12 cycles. This is necessary to expel all the air from the hydraulic system. After air has been deleted from hydraulic system, the proper level or amount of fluid in the reservoir should be checked. This level is noted by a gage on the side of the reservoir. A red line has been painted on the gage to indicate, the proper level of the fluid. With the landing gear in the down position and the pressure gage reading 1000 p.s.i., the level of the fluid in the reservoir should be even with the red line on the reservoir gage. This is providing the ship is level. If the ship is on its beaching gear the level of the fluid in the reservoir should be approx. 1" above the red line on the gage. Disconnect the test stand or stop engine motor.

### b. Adjustments of Unlatching Jacks, Sequence Valves, Actuating Cylinders

(1) Unlatching Jacks -- The unlatching jacks (Pesco #523) operating the main gear down locks are known as "down lock jacks" and are located on the inside of the hull at the upper end of each wheel well. The shaft of these two jacks protrudes through hull and contact bellcranks which operate down locks on the main gears. A plunger type of adjustment screws into the shaft of these unlatching jacks. A clearance of 1/8" between adjusting button and bellcrank on the main gear is necessary for these jacks to operate.

(2) The Uplock Jacks -- The uplock jacks (Pesco #523) are located on the inside of the hull just below the centerline of the wheel well and their shafts protrude through the hull and couple to uplock mechanism. The adjustment of this jack is made with the main wheels off and "0" pressure on the hydraulic system. The linkage to the uplock should be adjusted to engage with the main gear when the gear is in the up position.

(3) The Uplock Jack for Nose Gear (Pesco #523) is located inside the hull at the upper part of the auxiliary keel just inboard of co-pilot's left control pedal. This jack protrudes through the keel and operates uplock latch of the nose wheel. With the nose gear in the up and locked position, 1/32" clearance between unlatching jack and locking latch must be maintained.

(4) The Downlock Jack for Nose Gear (Pesco #523A) is located forward of bulkhead #1 just above the door lock and sequence valve in the bilge. The shaft of the jack protrudes into the nose wheel well to contact the downlock latch. The clearance between the latch and adjustment button of the jack is 1/32" when the nose gear is in the down and locked position.

(5) Sequence Valve Adjustments

The two Mechanical Sequence Valves located just aft of bulkhead #2 are adjusted as follows. The valve located farthest inboard and vertical is adjusted as follows: Screw adjusting nut on shaft of plunger as far as possible. Open nose doors to within 1/2" of touching outside skin. Place cap on plunger so that torque arm crank contacts plunger and operates valve 3/16" plus or minus 1/32". (Caution: Be sure plunger in valve does not bottom). Check operation of valve several times by opening and closing doors. Be sure no interference is encountered as torque arm passes over valve. The other valve is located outboard and at an angle. Adjustment is made with nose doors completely closed. Screw adjusting nut on shaft of plunger as far as possible. Close nose doors. Adjust cap on plunger so that torque arm crank contacts and operates valve 3/16" plus or minus 1/32". (Caution: Be sure plunger in valve does not bottom).

(6) The Snap Action sequence valve is adjusted as follows: The snap action sequence valve located on starboard side of auxiliary keel has a screw plunger type of adjustment in forward end of shaft. This plunger is operated by contact with bell crank attached to nose wheel torque arm. This valve plunger is actuated approximately 3/4" and should be adjusted to operate the last 1/8" travel of plunger when nose gear is moving to the up and locked position. A definite snap can be heard when valve operates.

(7) The Door Lock and Sequence Valve located forward of bulkhead #1 is adjusted as follows: Push mechanical emergency door-locking arm aft so that aft end of door locking pins are 1/8" plus or minus 1/16" forward of rear face of bulkhead #1. Bottom the piston side of valve (which is starboard side of valve) by pushing piston shaft into valve. Adjust clevis on shaft of piston to align with door locking assembly. Attach and tighten lock nut on piston shaft. (Caution should be exercised in the tightening of bolts on all clevises and linkages so that bolts are loose enough to allow mechanism to operate freely.) After above adjustment has been made, adjust sequence side of valve (port side of valve) so that plunger is operated 3/16" plus or minus 1/32".

### c. The Actuating Cylinders, Main Landing Gear, Nose Gear, Nose Doors.

(1) The Main Landing Gear Cylinders, located in main wheel wells, are adjusted for over-travel as follows: Check cylinder end caps and clevis on shaft for proper installation of bushings. Check supporting universals for bushings. Install universals and connect to actuating cylinder. Adjust over-travel with main gear in locked down position; extend piston until bottomed in end of cylinder. Connect to "V" strut with piston in this same position. Adjust clevis in or out of shaft to align with universal link. Disconnect from "V" strut; back clevis out of shaft 1/4"; reattach. (Caution - Upper end of cylinder head does not come in contact with jacknife strut).

Nose Gear Actuating Cylinder is located forward of bulkhead #1 and connects to lower end of bell crank attached to nose wheel torque arm. Check cylinder and clevis for bushings with nose gear in down and locked position. Adjust clevis in shaft of cylinder half way, and align with bell crank. Attach, then remove bolt. Screw clevis of cylinder into shaft 1/4". Reattach to bell crank. Operate gear hydraulically, nose gear should latch with positive engagement, and it should not be possible to hold nose gear from locking. If gear can be held from locking, screw clevis into cylinder 1 or 2 more turns until nose gear cannot be withheld from latching.

The Nose Door Actuating Cylinder is located just aft of bulkhead #2 and to port of centerline of ship. Check cylinder for bushings. Close doors completely. Screw clevis into piston shaft half way. Extend shaft until bottomed against cylinder end cap. Attach to torque arm link. Remove, back out clevis in shaft 1/4", reattach. The stop bolt located in port side of cylinder is adjusting bolt which regulates open travel of nose doors. Open doors to within 1/2" of touching outside skin. Screw bolt into cylinder until it contacts piston. Back off one turn, lock into position.

## 3. Operation Failures and Remedies

Service personnel can cure operational failures of gear by making systematic individual unit adjustments by following remedies suggested:

### Landing Gear in Down Position Preparatory to Being Raised

| TROUBLE | CAUSE | REMEDY |
|---|---|---|
| Nose wheel gear will not raise. | Down lock (523A jack) is not functioning as a sequence valve. | Check clearance between down latch and adjustment button. Screw adjustment into shaft of jack 1 to 2 turns. At least 1/32 in. clearance should be maintained. |
| Nose doors will not close. | Snap action sequence valve adjustment. | Screw out adjustment in shaft of valve until engagement with bellcrank is sufficient to operate valve when nose gear is in up and locked position. |
| Nose doors closing or creeping before nose gear is up and locked. | Snap action valve is by-passing. | Remove valve, service or replace with new one. |
| Failure of nose door locking pins to lock. | Mechanical sequence valve aft of blkhd. #2 not operating. | Back off adjusting cap plunger until valve operates, making sure plunger does not bottom in valve. |
| Irratic action of both door and nose wheel in relation to each other. | The Check Valve aft of blkhd. #1 on bottom of ship. Check Valve painting in wrong direction. Arrow on Check Valve should point starboard. | The Check Valve between the line from uplock and down line of selector valve leaks. Replace or reservice. |

| TROUBLE | CAUSE | REMEDY |
|---|---|---|
| Main landing gear fails to raise. | Down lock jacks (523) improperly adjusted. | Adjust button in shaft of jack to 1/8" clearance between bellcrank and adjusting button. Sometimes a little more clearance is needed to make jack operate properly. |
| | Return valves are by-passing | Replace or reservice valve. |

## Operation of Gear from Up to Down Position

| TROUBLE | CAUSE | REMEDY |
|---|---|---|
| Nose door locking pins will not unlock. | Generally, mechanical linkage. | All moving parts attached to locking mechanism should be free. |
| Nose doors will not open. | Sequence side of door lock and sequence valve is not operating | Back off adjustment cap on plunger until sequence valve operates and opens doors. |
| Nose wheel unlocks and starts down before doors open. | Mechanical sequence valve is by-passing or holding open. This valve is one mounted vertically aft of blkhd. #2. | Replace, or service valve. |
| With doors fully open, nose wheel remains in the up and locked position. | Vertically mounted sequence valve, aft of bulkhead #2 is not operating. | Unscrew cap on plunger of valve until nose wheel unlocks. |
| Nose wheel unlatches but will not go down and lock. | Unlatching jack (523) is not acting as sequence valve. | Check clearance between up latch and unlatching jack. 1/32" clearance should be maintained. In some instances slightly more clearance is necessary for operation of nose gear. |
| Main landing gear is restricted in its operating down position. | Return valves are not working properly. | Replace or service. |

| TROUBLE | CAUSE | REMEDY |
|---|---|---|
| Main landing gear will not lock down. | Return valves are by-passing through check valve. | Same as above. |

## 4. Troubles and Remedies Pertaining to Individual Units

| TROUBLE | CAUSE | REMEDY | EFFECT |
|---|---|---|---|
| Engine-driven pump failure in flight. | Engine failure, sheared shaft, or broken part. | Dismantle, replace broken parts, lower landing gear by emergency means or land as boat. | No hydraulic pressure for operation of gear. |
| Broken pressure line or suction line in flight. | Vibrations or gun fire. | Same as above. | Loss of fluid from main system but not pressure for brakes. |
| Unloading valve sticking on ground. | Foreign material or broken spring. | Remove from ship, dismantle replace broken parts & clean thoroughly. Give unit normal operation test on test stand before installing. | Properly operating valve will keep accumulator pressure between 800 and 1000 psi. while operating on engine pump or through test stand. |
| Unloading valve sticking in flight. | Same as above. | If it is desirable to use gear for landing, pump gear down with emergency hand pump and pump 1000 psi. in accumulators for use of brakes. | No pressure will show on gage. |
| Leaking. | Loose bolts or bad gasket. | Tighten bolts on cover plates Replace gasket. | Leakage will stop. |

| TROUBLE | CAUSE | REMEDY | EFFECT |
|---|---|---|---|
| Erratic action | No air in accumulators. | Inflate to 600 p.s.i. as mentioned in maintenance section. | Provides proper cushion for operating unloading valve. |

NOTE: There is no pressure adjustment on the unloading valve. If the operating pressure becomes altered, the unit must be returned to the manufacturer for correction. Vickers Inc. Detroit, Michigan.

Hand Pump

| TROUBLE | CAUSE | REMEDY | EFFECT |
|---|---|---|---|
| Will not pump pressure. | No oil in reservoir. Faulty check valve | Fill reservoir. Dismantle, replace, or lap seat for ball check. | Impossible to operate gear by emergency pump. |
| Leakage around piston shaft. | Faulty packing. | Replace packing. | (Note: A 5/16 steel ball has to be placed in pressure port on top of pump in order for pump to operate properly). |

| TROUBLE | CAUSE | REMEDY |
|---|---|---|
| Accumulators | | |
| Will not hold charge of air. | Faulty valve core. | Replace core with Schrader #1939 or Dill 100DBB. |
| Oil leaking around sides of accumulator or oil in air side. | Faulty diaphragm. | Replace diaphragms. |

| TROUBLE | CAUSE | REMEDY |
|---|---|---|
| **Relief Valve** | | |
| By passing. | Foreign material under check valve seat. | Disassemble. Clean thoroughly, relap seat if necessary. |
| Improper setting. | Out of adjustment. | Adjust and set for 1250 p.s.i. Pressure adjustment is located on top of valve. |
| **Return Valves** | | |
| Internal leakage or by-passing. | Faulty packing or foreign material under check valve seat. | Replace packing, relap check valves. Clean thoroughly. |
| **Selector Valve** | | |
| Will not build up pressure. Leaks internally. | Improper setting of thermal relief valve or foreign material on valve seat. | The thermal relief is on side of valve and should be adjusted to 1250 p.s.i. If foreign material is creating leakage, relap seat. Sometimes the poppets in valve also need to be relapped in the process of reservicing. |
| **Actuating Cylinders** | | |
| Leakage around shaft. | Improper adjustment of packing. Faulty packing. | Try tightening packing retaining nut. If leakage still persists remove old packing; replace with new. |
| **Latch Releasing Cylinder** | | |
| By-passing. | Foreign material on poppet seat or mechanical binding. | Dismantle, relap poppet seat or free binding. Clean thoroughly. |
| Leakage out bleeder hole. | Faulty packing. | Dismantle, replace packing around piston. |
| Piston will not operate. | Mechanical restriction or broken spring | Dismantle free piston; replace spring. |

| TROUBLE | CAUSE | REMEDY |
|---|---|---|
| **Sequence Valves** (Mechanical) | | |
| By-passing. | Foreign material on poppet seat. | Dismantle, clean, relap poppet seat. |
| Plunger sticking or holding open. | Mechanical binding. | Dismantle. Use emery cloth to obtain clearance between spool and guide; clean thoroughly before reassembling. |
| **Snap Action Sequence Valve** | | |
| By-passing. | Piston holding open or foreign material on ball valve seat. | Disassemble; loosen retaining nut. Relap ball seat. Clean thoroughly. Reassemble. |
| Leakage around plunger. | Faulty packing. | Disassemble; replace packing. |
| **Power Brake Valve** | | |
| By-passing. | Poppet valves holding open. Foreign material on Bullet Valve seat. | Disassemble; relap valve seats. Caution should be exercised to note clearance between poppet valve cams and bullet valve. This clearance is approximately .010". |
| Mechanical binding. | Clearance of push rod, or sliding sleeve. | Polish push rod until it operates freely in its retainer guide. Clean thoroughly. Lap sliding sleeves together with oil. (Use no compound). These sleeves are an oil lapped fit and the slightest foreign material will cause binding. |
| **De-boosters** | | |
| Brakes will not release. | Compensating check valve leaks. | Dismantle; relap ball check seat. |
| Emits air and external leakage. | Faulty packing. | Replace packing, clean thoroughly. |

| TROUBLE | CAUSE | REMEDY |
|---|---|---|
| Filter | | |
| Handle will not turn. | Clogged with foreign material. | Dismantle; clean plates thoroughly. |
| External leakage | Faulty gasket. | Replace gasket. |

NOTE: It is advisable to read the general notes on servicing of hydraulic units before attempting repairs.

## 5. General Service Notes

### a. General

In servicing, repairing, or testing units, it is advisable to replace units that are not functioning properly with spares, providing they are available. In cases where emergencies are encountered, the least possible disassembly of unit is suggested. Repairing units normally requires the facilities of testing equipment. There are definite testing procedure specifications to follow with each unit. This information can generally be acquired from desired vendors. A definite procedure of disassembly, repairing, reassembly, and testing should be acquired. Men working with this equipment should have experience along this line.

In replacing packing, care should be exercised in removing or replacing, not to distort, or injure feather edges. Also, a thin coating of vasoline should be applied before installation.

In lapping of Valve or Ball Check seats, a very fine grade of lapping compound should be used. Namely; Cloverleaf Grade 2-A.

In cases where solvent is not available to clean all parts thoroughly, clean parts in regular hydraulic fluid, A.C. #3580 or M-339. This is very important. A minute particle of foreign material can prevent units from performing their proper function.

### b. Bleeding the Brakes

The maintenance of the brakes is comparatively simple. In general, they must be kept free of air by bleeding periodically. Frequently, bleeding is made necessary by the entrance of air in the system during repairs to other parts of the hydraulic system. The presence of air in the brakes is detected by sluggish releasing, dragging, or no braking action. The bleeder fitting is located on the inboard side of each wheel near the top of the drum. To bleed the brakes, hold a wrench on the bleeding fitting and remove screw and washer from end of the fitting. With accumulator pressures up (600 p.s.i. air, 1000 p.s.i. oil) insert bleeder hose in end of fitting and insert other end of hose in a container of clean hydraulic fluid. Depress brake pedal and open bleeder valve one or two turns. Keep end of bleeder tube under oil. Bleed brakes until all air bubbles are out of the system and fluid runs clear. Release the brake with the bleeder tube still under the oil. In the process of bleeding the brake, release the brake pedal at intervals. After all air has been expelled, remove bleeder hose and reinstall screw and washer in the end of the bleeder fitting. Replenish the system with same amount of fluid used in the bleeding of the brakes.

## c. Standard Test and Inspection Procedure

This has been set up by Consolidated for amphibian airplanes which is a helpful procedure to follow for periodic overhaul and inspection.

Hydraulic Test Procedure for PBY-5A and 28-5AMC

(1) Check accumulators for air charges before conducting the test. Air charge in both 10" accumulator and 5" accumulator must be 600 p.s.i. plus or minus 25 lbs. Make sure no oil is in the accumulator when checking above.

The accumulators should be inspected at least once a week. The methods for checking the air pressure in the 5" and 10" accumulator are as follows:

Jack up airplane and operate selector valve handle back and forth a few times to relieve the 5" accumulator of oil. When oil is being relieved in the accumulator, watch pressure gage on pilot's instrument panel and the last definite pressure shown on this gage, before it falls back to zero, is the amount of air pressure in the 5" accumulator.

When checking the air pressure in the 10" accummulator, the fluid again must be relieved. To relieve fluid, operate brakes back and forth constantly for approximately 10 or 15 minutes, or until no further foot reaction is felt. After oil is relieved, attach a booster pump or other air charging device incorporating a pressure gage, to the air valve on the bottom of the accumulator and read the air pressure on the gage. A pressure gage is installed in the pressure line leading to the 10" accumulator. Reading the air pressure in this accumulator with the above gage incorporated will be done in the same manner as noted above for checking the 5" accumulator, except that the oil pressure is relieved by operating the brakes instead of the landing gear selector valve handle. Should the air valve core be removed from either accumulator at any time, it cannot be reused and must be replaced with either a Schrader #1939 or Dill #100-DBB type core. Replacement of removed valve cores with the correct new core is considered very important for maintaining the proper operation of the accumulator. Do not use valve cores for automobile tires as replacement valve cores in airplane accumulators.

(2) Normal Operation of Landing Gear - 5 consecutive operations -- At each operation, check the following items:

(a) Check landing gear operating handle for locking device and general operation.

1. Selector valve handle must remain in down position until ready to raise the gear. Do not return to neutral. It must not be possible to move handle from down position without first pulling lock pin.

2. Lock pin knob must snap back in when handle is returned to "Gear Down" position.

(b) Check indicator lights for "Locked up" and "Locked Down" positions.

(c) In "Gear Down" position, check all down latches for full engagement.

(d) In "Gear Up" position, check all up latches for full engagement. Check nose wheel door plungers for full engagement in closed doors.

(e) Check nose wheel doors for creep during retraction of the nose wheel. Creep indicated leaking the snap-action sequence valve.

(f) Check the nose wheel up latch.

1. The latch must not release the nose wheel gear before the doors are fully open.

2. When raising the nose wheel, the up latch must be in the latched position before the nose wheel locking pin engages the hook.

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(g) Check the nose wheel sequence valves.

1. There are four sequence valves. Two are located at the rear face of Bulkhead #2, one is incorporated in the door lock and the last is the snap-action sequence valve located at the R.H. side of the auxiliary keel.

2. The sequence valves must be operated full stroke without overtravel sufficient to cause excessive deflection of the brackets.

(h) Check all flexible hose connections.

1. Check the white line on the hose for twisted installation.

2. Check for sharp bends and kinks during operation.

3. Check for chafing.

(3) Emergency operation of the landing gear.

(a) Simulate complete loss of hydraulic pressure with gear up as follows:

1. Stop test stand pump.

2. Remove air valve core from 5" accumulator.

3. This test must be conducted with full 1000 p.s.i. pressure in the 10" accumulator and brakes must not be operated until system has been operated several cycles normally. Otherwise, air may be admitted to the brake system.

(b) Lower landing gear by emergency means once.

1. Check down and locked indicator.

2. Check lower latches.

(c) Restore system to normal status as follows:

1. Replace the 5" accumulator valve core with a new core. Use Schrader #1939 or Dill #100-D.B.B.

2. Inflate the 5" accumulator to 600 lbs. air pressure. Operate the landing gear control valve "up" and "down" several times to be sure oil is out of the 5" accumulator while charging with air.

3. Operate the landing gear at least three cycles normally to remove air from the system.

(4) Check Brakes -- Apply full on and release 10 times.

(a) Check release each time.

(b) Complete release must take place within three seconds after foot pressure is released. Measure release by applying a 20-lb. tangential force at the outside of tire. (Use strap fixture with 20-lb. weight.)

(5) Check oil level according to instructions at reservoir.

(6) Check hand pump. Operate landing gear through one complete cycle using hand pump.

(7) Check engine-driven pump by operating brakes during engine run.

d. Methods for Testing

It has been mentioned previously that in order to completely test operation of the gear, the ship has to be on its beaching gear with both main wheels removed or on special jacks designed for this ship.

It is more convenient to operate the gear hydraulically with ship on its beaching gear. There are three procedures in attaching the beaching gear to the ship; namely --

(1) If the ship is near the water, proceed as follows: With the ship in the water, attach the beaching gear. Put the selector valve in the up position and break the main gear locks. This will allow the gear to ride on its two main wheels without supporting the weight of the ship. After the ship is beached and the ship is on its beaching gear, remove the wheels prior to hydraulic operation.

(2) If the ship is on land, either of the following two procedures can be used:

(a) This method would not be used unless the following ramps are available. Dimensions of ramps are as follows: 44" wide x 20' long x17" high with a gradual incline of 8° for 16'; the remaining 4' of ramp is level. Attach the beaching gear to the ship. As the ship is pulled onto the ramps, hold the tail of the ship down on its tail beaching gear. The wheels do not have to be removed for hydraulic operation.

(b) This method would not be used unless the following pits are available. Dimensions of the two pits are as follows: 14'-8" apart, 2' wide x 16' long x20" deep with an approximate decline of 8° for the length of 12'. Install the beaching gear on the ship with all main wheels locked. As the ship is pulled into the pits and the weight of the ship is transferred to the beaching gear, hold the tail of the ship down on its tail beaching gear.

### e. Priming Engine Pump

This can be accomplished in two ways:

(1) By using the emergency hand pump and pumping pressure into the system until the hydraulic pressure gage reads slightly over 1000 p.s.i. This will put the unloading valve in partial unloaded condition. When the engine pump is started, the unloading valve will complete its function cycle by unloading and permitting free flow of fluid back to the reservoir.

(2) Break down system pressure by operating the selector valve handle to up and down positions, until "0" pressure is noted on the hydraulic pressure gage.

CAUTION: (This is very important) If, at any time, the pressure in the hydraulic system is dissipated by the operation of the selector valve, all down locks must be blocked so they will not operate when the selector valve is operated. This can be accomplished by cutting blocks of wood and inserting and securing under locks.

### f. Building Up Pressure in System

If pressure will not build up, a systematic procedure in locating the trouble should be followed.

(1) Prime the pump as outlined above.

(2) Make sure the check valve under the reservoir in the engine pump pressure line is pointing aft.

(3) The Pesco Relief Valve is by-passing or the Unloading Valve is sticking. Try tapping the units with a rubber or rawhide mallet. In most instances, valves will start to function.

(4) The brake valve is by-passing. Use method mentioned above.

NOTE: (Items (3) and (4) can be accomplished in flight as well as on the ground).

### g. Low Oil Pressure in System:

A condition may exist where there is a lack of oil pressure in the system, but the gear can be operated with the hand pump. This is due to the reservoir being divided into three sections: (1) the top for foaming space; (2) the middle for system operation, and (3) the bottom for hand pump emergency operation. Therefore, if the accumulators have insufficient air pressure and fill up with oil from the reservoir, it is possible that enough oil would not be left in the middle or system section of the reservoir to operate the gear through a complete cycle. However, the hand pump could complete a cycle because it draws its oil from the bottom of the reservoir and the filling of the accumulators with oil would not affect the oil supply to the hand pump.

If the hydraulic pressure gage shows a pressure between 200 and 300 p.s.i. when starting to operate the gear, check the following items in the order given:

(1) Pressure Relief Valve - should by-pass at 1250 p.s.i.

(2) Unloading valve - Inspect to determine that it is opening and closing at the correct pressures. (Unload at approximately 1000 lbs. and load at approximately 850 lbs.)

(3) Air pressure in accumulators.

(4) Oil level in reservoir.

On inspection of the oil reservoir, the oil level may appear to be low. The next check should be to inspect both the 5" and 10" accumulators for air pressure before adding oil. The reason for this inspection is that, if accumulators are not charged, they will fill up with oil from the reservoir. This condition, of course, would show the reservoir to be low. If reservoir were filled and then accumulators relieved of oil for checking the air pressure, the reservoir would overflow.

The oil reservoir should be checked regularly, at least once a week, to make certain that the oil level is not below the red line shown on the reservoir gage, under conditions described on the nameplate attached to the reservoir.

### h. Flushing the System

Flushing of the hydraulic system is necessary only when the wrong type of fluid has been introduced in the system. The filter will normally keep the system clean. It is very essential to use the correct fluid when flushing the system. Carbon tetrachloride or trichlorethylene must be used in order to dissolve the hydraulic fluid and not leave a residue. The use of other flushing fluids will affect the internal mechanism and packing.

NOTE: The ship must be jacked up, on beaching gear or ramps so the complete system can be operated.

(1) Flushing System when Test Stand is Available.

(a) Drain hydraulic reservoir. Attach hose specified on test stand block to suction side and drain reservoir.

(b) Drain oil from accumulator. If pressure is indicated on hydraulic gage, dissipate pressure. This will empty the oil from the 5" accumulator to reservoir. Attach bleeder hose to either right or left brake. Open bleeder valve and apply parking brakes to expel fluid trapped in 10" accumulator.

(c) Drain oil from filter by removing drain plug and replacing same.

(d) Secure both test stand connections.

(e) Release parking brakes.

(f) Close bleeder valves.

(g) Fill test stand reservoir with Carbon Tetrachloride or trichlorethylene flushing fluid.

(h) Start test stand and operate system through several operations.

CAUTION: It is advisable to connect a hose from vent on top of reservoir (5/8" hose preferable) to allow fluid from system to continuously overflow and return to test stand reservoir. In so doing a visual check can be made on color and consistency of the fluid.

(i) After the system has been flushed, flushing fluid must be drained from the hydraulic system as well as the test stand. It will be necessary to drain the system several times. Then re-fill with Spec. #3580 or M-339 and continue circulating this fluid until all trace of flushing fluid has been removed.

(2) Flushing System When Test Stand is Not Available.

After system has been drained, flushing fluid (carbon tetrachloride or trichlorethylene) should be placed in reservoir and a man stationed at the reservoir with sufficient amount of fluid to keep the reservoir filled to the proper operating level. Follow procedure as previously outlined, continuously filling reservoir when fluid drops below normal level.

CAUTION: This procedure of flushing system should not be attempted unless absolutely necessary. It is quite difficult to keep the system supplied with fluid while engine is running.

## 6. Hydraulic Service and Maintenance for Sperry Automatic Pilot Installation

### a. General

Automatic Pilot on subject airplanes is similar to that used on other models except that oil under pressure is supplied to the pilot from the main hydraulic system instead of from a separate pump and reservoir. This is done by the use of three additional units: Vickers (644256), Sperry Relief Valve, A.A.C. (58001) Sump Pump, and A.A.C.(32004) Restrictor Valve.

b. The Vickers (644256) Sperry Relief Valve is located on the hydraulic platform and operates off the return line of the unloading valve. The purpose of this valve is to build up back pressure in the return line of the hydraulic system to 150# p.s.i., the pressure required to operate Sperry pilot. Pressure from this valve is cut off during operation of the landing gear. The starboard port of valve connects directly to the port side port of unloading valve. The pressure side of this valve connects directly to Sperry "ON" and "OFF" control valve, located on port side of instrument panel. The return line connects to bottom of valve and to starboard side of filter.

c. A.A.C. (580011) Sump Pump is located on the aft side of Bulkhead #1 and operates in conjunction with the automatic pilot by removing excess fluid in pilot sump. This pump does not operate when gear is going up or down, because the fluid supply source is cut off by operation of the unloading valve.

d. A.A.C. (32004) Restrictor is located just above and close to the pressure inlet port of sump pump and controls the cycles of operation by adjustment provided. This restrictor is adjusted to operate sump pump at the rate of 120 strokes per minute.

### e. Troubles, Causes, Remedies

| TROUBLE | CAUSE | REMEDY |
|---|---|---|
| Relief Valve 644256.<br>Pressure Drop. | Broken spring.<br>Out of adjustment. | Disassemble and replace.<br>Readjust. |
| Complete Failure | Foreign material, Piston fouled. | Disassemble, clean thoroughly, remove foreign material. |
| | Bad valve seats. | Relap valve seats. Test and reset to specifications of valve. |

Revised 4/1/42
C.A.C.

Troubles, Causes, Remedies (Continued)

| TROUBLE | CAUSE | REMEDY |
|---|---|---|
| Sump Pump (58001) Stops Operating. | No pressure | Check Sperry relief unit. |
| | Walking beam and spool guide not synchronized. | Remove front cover, disassemble, readjust stroke of walking beam. Remove and replace broken parts. |
| | Faulty packing. | Remove from piston and replace with new packing. |
| No Suction | Foreign material on seats of ball checks. | Relap ball check seats and clean thoroughly. Check operation on test stand. |
| Restrictor 32004 External Leakage. | Faulty Gasket. | Replace gasket. (This type of restrictor rarely requires servicing. Changing of adjustment would probably be all that it would require). |

In the Model PBY-5A airplanes, beginning with No. 1 airplane of contract No. 88476, the Sperry automatic pilot has been installed by Consolidated. An overflow sump tank has been added to prevent external leakage of the balanced oil valves of the automatic pilot. It should rarely require servicing.

If Sperry automatic pilot needs servicing or repairing and troubles encountered are other than those listed in regular service manual, furnished by Sperry, it would be wise to consult them regarding procedure to follow.

CAUTION - Do not turn on Sperry Pilot while operating main landing gear.

## 7. Inspection and Check for Nose Door Operating Mechanism

### a. General

With the airplane cradled as described in Section IV, J, 5, d, or with the airplane on the beaching gear with main wheels removed, check the following:

(1) With doors in the open position, make certain that the locking pins are only 1/8" visible. If this distance is greater, the doors will be subject to scratching in operating them to the open or closed position. If the locking pins project too far out, the doors will be prevented from closing flush with the hull. This condition is caused by the door sequence valve bypassing.

(2) With the doors in the closed position, note that the locking pins mate properly with the holes in the doors. Check that the doors are flush with the hull and the centerlines are in line with the keel.

### b. Checking Operation of Nose Wheel & Door Sequence

#### (1) Sequence of Operation for Extension

##### (a) Door Lock and Sequence Valve

Lock pins pushed back to unlock doors, after which sequence valve is unseated to keep line open to rest of system.

##### (b) Door Actuating Cylinder

Piston rod retracts to rotate torque tubes, thus opening the doors.

##### (c) Sequence Valve (Vertical)

Opens only after the doors have been fully opened.

##### (d) Up-Lock Unlatching Cylinder

Unlocks nose wheel and opens line for next sequence of operation.

##### (e) Retracting Cylinder

Piston rod retracts, pulls down nose wheel until wheel is down and locked.

#### (2) Sequence of Operation for Retraction

##### (a) Down Lock Unlatching Cylinder

Unlocks nose wheel and opens line for next sequence of operation.

(b) Retracting Cylinder

Pushes up the wheel until it is locked.

(c) Snap Action Sequence Valve

Snaps open at last 1/8" travel.

(d) Door Actuating Cylinder

Rotates torque arms to close door.

(e) Sequence Valve (Outboard)

Opens line to door lock mechanism. (Only after doors are fully closed).

(f) Door Lock and Sequence Valve

Pushes pins forward to lock door.

c. Valve Adjustments

A complete inspection of nose door operation must necessarily include adjustments to the following units:

(1) Sequence Valve Adjustments

Refer to Part 2, b of this section.

(2) Snap Action Sequence Valve Adjustment

Refer to Part 2, b of this section.

(3) Door Lock and Sequence Valve Adjustment

Refer to Part 2, b of this section.

d. Visual Inspection of Hydraulic Equipment in Bomber's Compartment

(1) Nose Wheel Door Lock System

Forward bulkhead #1 - bilge. Check the following:

(a) Mounting bolts (6) for cotter keys.

(b) Make sure check nuts are on door lock valve plunger and clevis.

(c) Important - check for cotter key on door lock valve clevis attaching to door lock bell crank.

(d) Emergency door lock release handle for "lost motion."

(e) Door lock plungers and plunger links for attachment and safety.

(f) Packing retaining disc and circlip on 28F6578 (ref.) door lock plunger bearing.

(g) Moving parts for freedom of operation.

(2) Nose Wheel Down Lock Cylinder

Forward bulkhead #1 - bilge. Check the following:

(a) Valve should be rigidly attached. Mounting bolts (4) are checked when inspecting nose wheel well.

(b) Proper type valve installed - should be Pesco #523A.

(3) Snap Action Sequence Valve

Check the following:

(a) Mounted with 3 bolts on starboard side of twin keel.

(b) Sufficient clearance, 1/32" should be maintained between valve and keel structure.

(c) Valve piston free from paint and foreign matter.

(d) Lock ring secures piston housing.

(e) End cap for lock wire.

(f) Valve must align with engaging bolt on retracting torque arm.

(4) Nose Wheel Door Operating Linkage

Check the following:

(a) Bolts (3) for cotter keys attaching to nose wheel torque tubes and nose wheel door actuating cylinder linkage.

(b) Check nut secure at clevis, starboard side of door operating linkage.

(c) Special bolt (28F6610) connecting clevis to nose wheel door torque tube casting. This bolt should be on the starboard side of door operating linkage. It engages the nose wheel sequence valve aft of bulkhead #2 which in turn allows the fluid to flow to the nose wheel door lock and sequence valve.

(5) Nose Wheel Door Lock Arm and Pin (Open Position)

Check the following:

(a) Location by fitting door lock arm and pin on starboard nose door torque tube with doors in the open position.

(b) Mounting bolts (6) secure.

(c) Lock pin and hair pin for fit in stowage.

(6) Nose Wheel Actuating Cylinder

Check the following:

(a) Casting mounting bolts (15) to hull structure cross beams.

(b) Casting for cracks at clevis attachment.

(c) Nose wheel cylinder hinge bolt attaching to casting for cotter key.

(d) Lock nuts (2), forward and aft end of cylinder for tightness.

(e) Packing nut and plugs (3) for tightness and proper lock wiring.

(f) Make sure check nut is drawn tight on piston shaft.

(g) Piston shaft should be 1/8" minimum from being bottomed with gear down and latched.

(h) Eye bolt on piston shaft for attachment to retracting torque arm - **safety** OK - (aft of bulkhead #1.)

e. Operation Failures and Remedies

Refer to Part 3 of this section.

f. Checking in Flight

(1) From the bomber's compartment, check the

nose door locking pins for full engagement with emergency locking pin handle.

(2) Aft of bulkhead #2 on port side, make sure nose wheel door cylinder piston jack is all the way out (premark the side of the bulkhead as an indication of full extension of piston rod).

(3) Insert hydraulic hand pump handle, or emergency lever handle in aft end of starboard door torque tube, located aft of bulkhead #2, and push inboard, rotating torque tube clockwise to make sure nose wheel doors are tightly closed.

(4) The position and operation of the nose wheel may be observed through a small window in the flooring of the pilot's compartment.

## K. Landing Gear (Ref. C.A.C. Dwgs. 28L5001, 5002, 5003 and 5004)

### 1. Description

#### a. General

The landing gear consists of two main units and a nose unit. The main units are retractable into wells in the sides of the hull; the nose unit retracts into a well in the bow of the hull. Doors close over the nose wheel well after the unit has retracted and open before the unit extends. The retracting mechanisms for all units and the door operating mechanisms are hydraulically operated and are all actuated from one selector valve located on the pilot's instrument panel. A 10" accumulator located on the main panel supplies fluid to the hydraulic main wheel brakes, which are operated from extensions on the rudder pedals. For arrangements of the gear, see Figures 60, 61 and 62 .

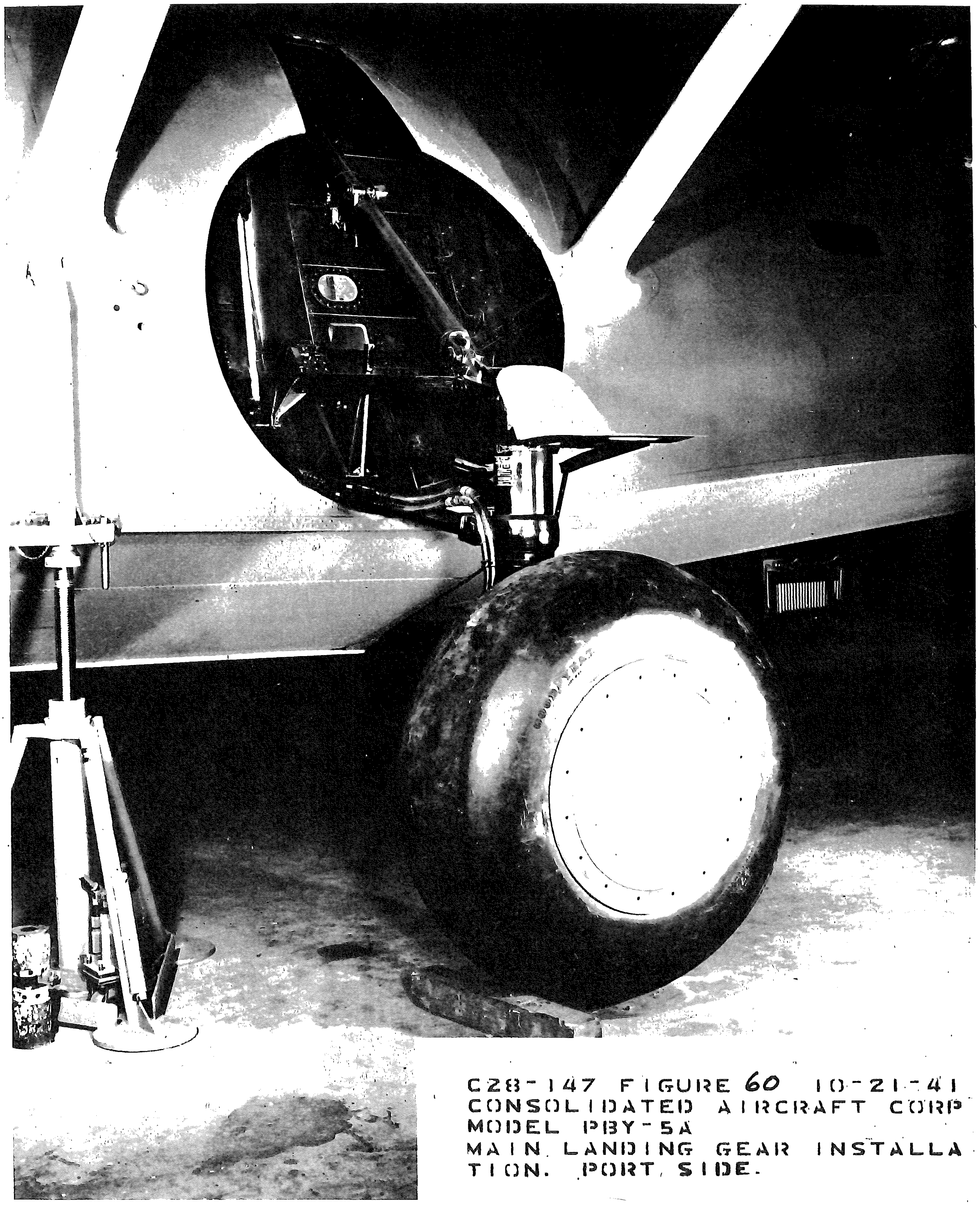
Signal lights on the pilot's instrument panel indicate "WHEELS DOWN AND LOCKED" when both main landing gear wheels and nose wheel are locked in landing position. Signal lights indicate "WHEELS UP" when the main landing gear unit has been raised, and "WHEEL DOOR LOCKED" when the nose wheel has been retracted and the door latched.

#### b. Main Landing Gear

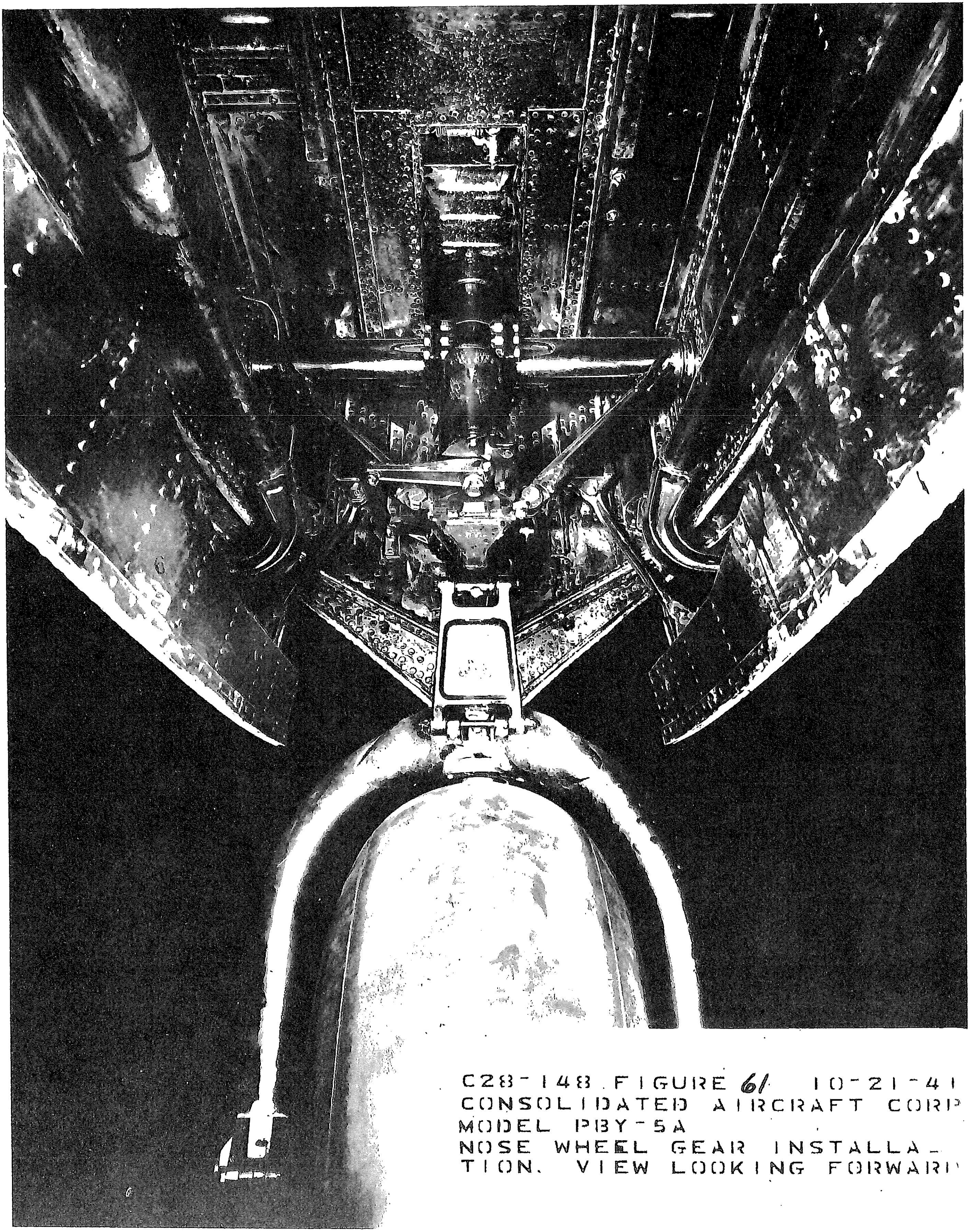
Each side unit consists of a 47", 10-ply, smooth contour tire (50 pounds inflation pressure), a Goodyear wheel and watertight brake assembly #530126, an Aerol shock strut (Cleveland Pneumatic Tool Co., Drawing #8103-L & -R) including oleo scissor and axle, a strut assembly, and hydraulic retraction mechanisms.

The strut assembly consists of two V struts, forming a parallelogram linkage, from the oleo to hull fittings at stations #4.2 and #5.0, and a main strut from the oleo to the upper inside of the wheel well. The main strut is broken near its center so that it may fold inward during retraction, being automatically latched into a rigid position when extended.

Retraction of each side unit is accomplished by the operation of two actuating cylinders. The small actuating cylinder near the upper hinge point of the main strut, actuates a rod outside the strut by means of a bellcrank also at the upper hinge point. This rod releases the spring loaded strut latch, allowing the main strut to be folded inward by the action of the main actuating cylinder. The main actuating cylinder floats between a bracket near the upper end of the main strut and a bracket on the forward leg of the upper V strut. By contracting, this actuating cylinder applies torque to the strut system, folding the main strut inward, and pulling the gear upward and into the well as shown on Figure 60 As the side gear approaches its retracted position, it has a tendency to fall into the well. On the inboard end of the wheel axle is a fitting equipped with a roller which, upon coming in contact with



C28-147 FIGURE 60 10-21-41
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A
MAIN LANDING GEAR INSTALLATION. PORT SIDE.



C28-148 FIGURE 61 10-21-41
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A
NOSE WHEEL GEAR INSTALLATION. VIEW LOOKING FORWARD

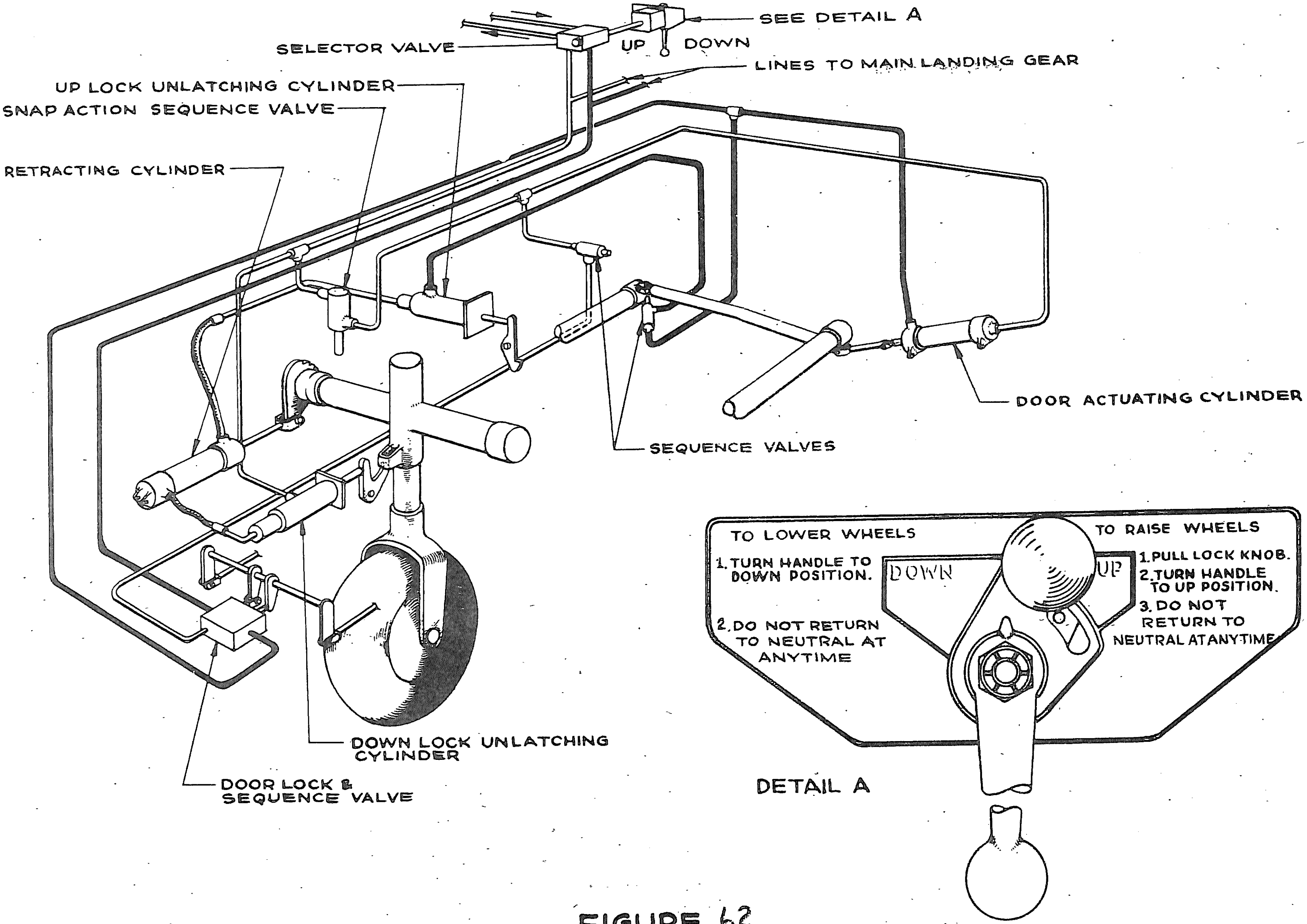
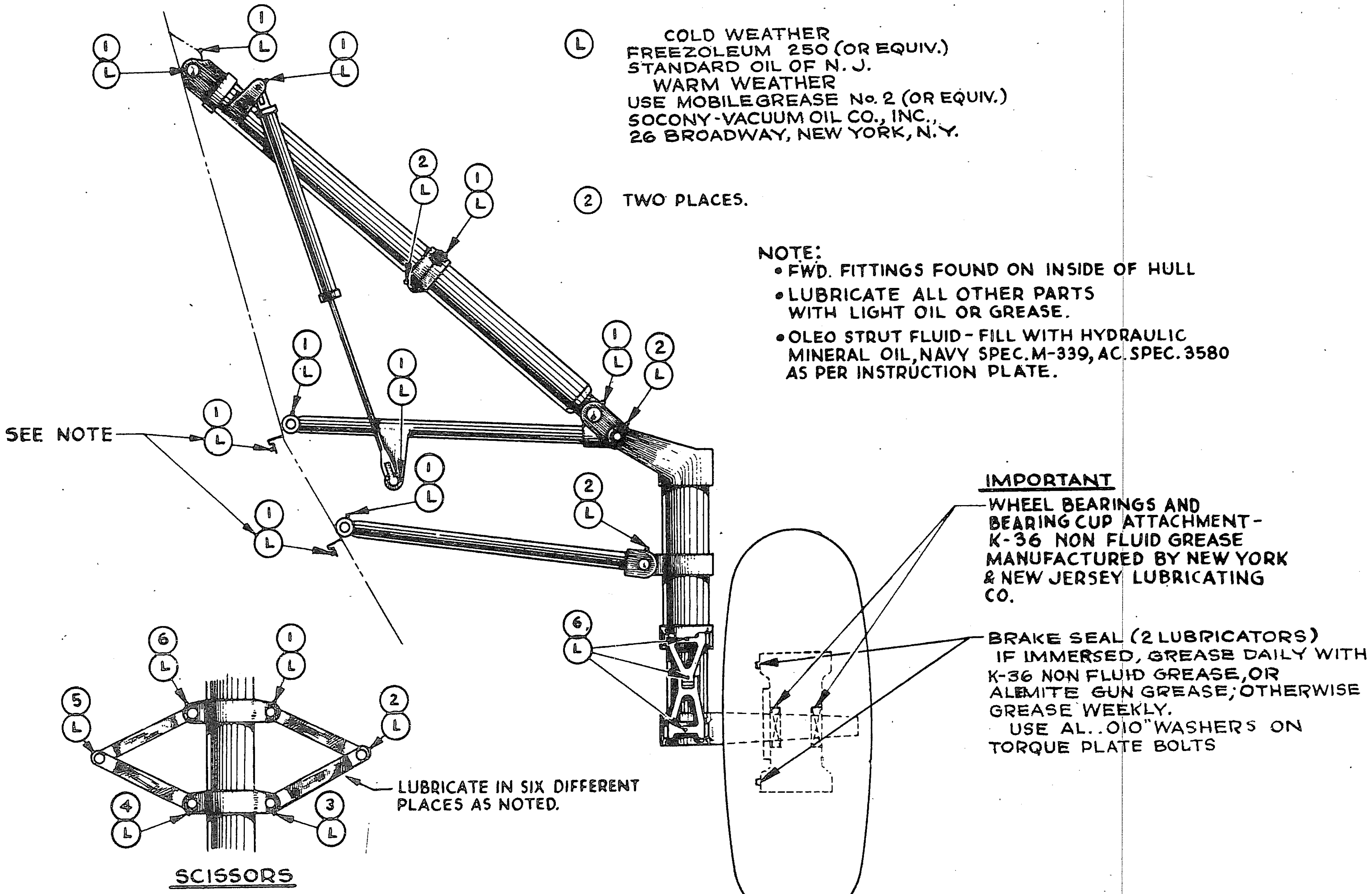

SEE DETAIL A
SELECTOR VALVE
UP
DOWN
LINES TO MAIN LANDING GEAR
UP LOCK UNLATCHING CYLINDER
SNAP ACTION SEQUENCE VALVE
RETRACTING CYLINDER
DOOR ACTUATING CYLINDER
SEQUENCE VALVES
DOWN LOCK UNLATCHING CYLINDER
DOOR LOCK & SEQUENCE VALVE
TO LOWER WHEELS
1. TURN HANDLE TO DOWN POSITION.
2. DO NOT RETURN TO NEUTRAL AT ANYTIME
DOWN
UP
TO RAISE WHEELS
1. PULL LOCK KNOB.
2. TURN HANDLE TO UP POSITION.
3. DO NOT RETURN TO NEUTRAL AT ANYTIME
DETAIL A

FIGURE 62
NOSE WHEEL HYDRAULIC SYSTEM



(L) COLD WEATHER
FREEZOLEUM 250 (OR EQUIV.)
STANDARD OIL OF N. J.
WARM WEATHER
USE MOBILEGREASE No. 2 (OR EQUIV.)
SOCONY-VACUUM OIL CO., INC.,
26 BROADWAY, NEW YORK, N.Y.

(2) TWO PLACES.

NOTE:
- FWD. FITTINGS FOUND ON INSIDE OF HULL
- LUBRICATE ALL OTHER PARTS WITH LIGHT OIL OR GREASE.
- OLEO STRUT FLUID - FILL WITH HYDRAULIC MINERAL OIL, NAVY SPEC. M-339, AC. SPEC. 3580 AS PER INSTRUCTION PLATE.

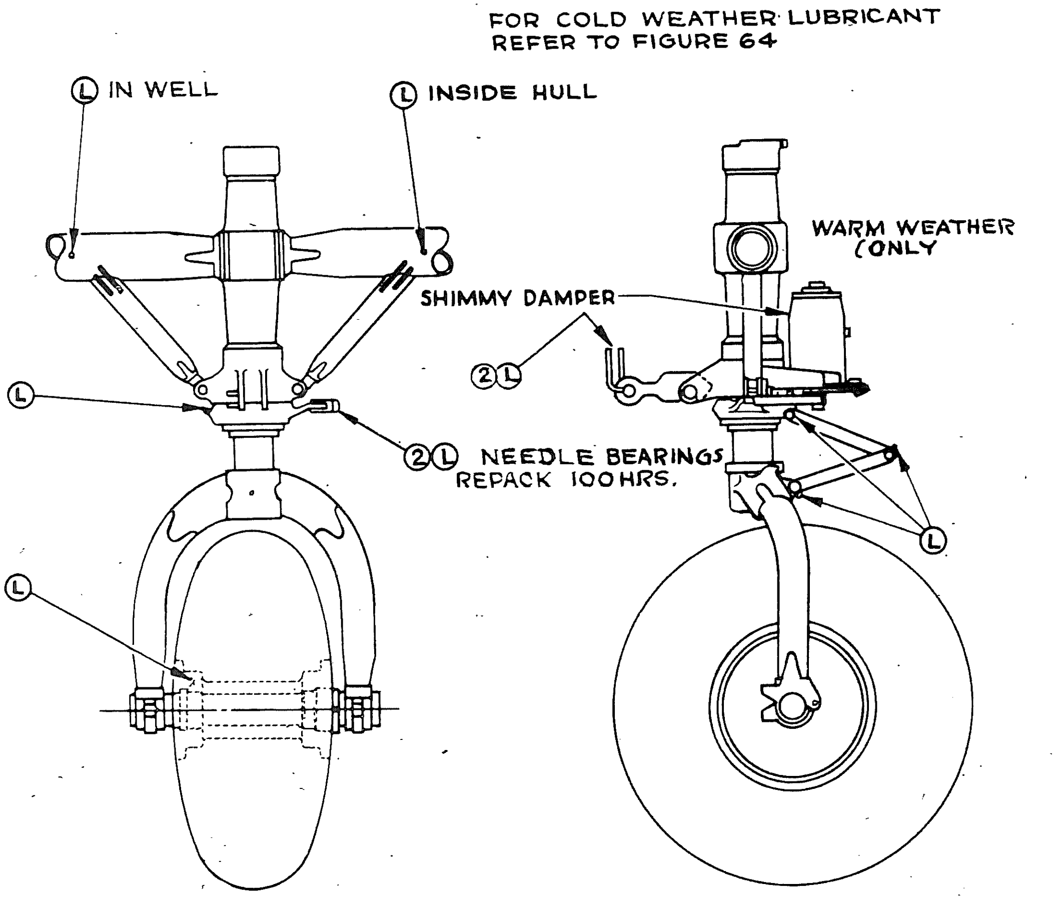
IMPORTANT

WHEEL BEARINGS AND BEARING CUP ATTACHMENT - K-36 NON FLUID GREASE MANUFACTURED BY NEW YORK & NEW JERSEY LUBRICATING CO.

BRAKE SEAL (2 LUBRICATORS) IF IMMERSED, GREASE DAILY WITH K-36 NON FLUID GREASE, OR ALEMITE GUN GREASE; OTHERWISE GREASE WEEKLY.
USE AL. .010" WASHERS ON TORQUE PLATE BOLTS

LUBRICATE IN SIX DIFFERENT PLACES AS NOTED.

FIGURE 63
MAIN LANDING GEAR LUBRICATION



REFER TO C.A.C. DWG. 28 L 5002

**SERVICE LUBRICATION**

USE MOBILE GREASE #2 (OR EQUIV.)
SOCONY-VACUUM OIL CO.
26 BROADWAY, NEW YORK, N.Y. AT PLACES MARKED Ⓛ, EXCEPT WHEEL ROLLER BEARINGS. FOR WHEEL ROLLER BEARINGS LUBRICATE:
WITH K-36 NON FLUID GREASE MANUFACTURED BY NEW YORK & NEW JERSEY LUBRICATING CO.

**OLEO STRUT**

FILL WITH HYDRAULIC MINERAL OIL, NAVY SPEC. M-339, A.C. SPEC. 3580 AS PER INSTRUCTION PLATE.

**SHIMMY DAMPER**

FILL WITH HOUDE ENGRG. CORP. STD. SHOCK-ABSORBER #1404 OR HIGH QUALITY MEDICINAL CASTOR OIL AS PER MANUAL.

FIGURE 64
NOSE WHEEL LANDING GEAR LUBRICATION

a spring bumper arm assembly in the well, cushions the shock of the fall as the gear reaches full retraction. This fitting, at the same time, is caught by a spring latch in the well which holds the unit in the retracted position.

When the side unit is to be extended, another small hydraulic actuating cylinder releases the "retracted position" latch, the main actuating cylinder extends, forcing the unit out into the extended position, and the main strut automatically latches in a rigid position.

A visual check of the down lock can be made if the indicator lights do not work or if any doubt is felt about the main landing gear being down and locked.

A schematic diagram of the landing gear hydraulic system is shown on Figure 57.

### c. Nose Wheel Gear

The nose unit consists of a single 30:00, 8-ply, smooth contour, tail wheel tire (50 pounds inflation pressure) with dual seal inner tube, wheel and axle, a fork from the axle to the oleo piston, an Aerol shock strut (Cleveland Pneumatic Tool Co., Drawing #8104), a strut assembly, and hydraulic retracting mechanism. The wheel can swivel 45° each side of center (fore and aft) position, but is automatically centered fore and aft by an internal cam in the oleo when the oleo is fully extended, i.e., whenever the nose wheel has no weight on it. The fork is scissored to a rotating collar on the oleo cylinder; a lever extending from this collar is linked to an arm on the hydraulic damper of the rotary vane type (Houdaille Corp. Drawing #A-8099 as modified). This mechanism provides for damping nose wheel "shimmy". The strut assembly consists of a pair of cross tubes bolted to the top of the oleo cylinder, their outer ends fitting into pivot bearings installed in the double keel, and diagonal tubes from the cross tubes to the lower portion of the oleo cylinder. The cross tubes serve as the axis of rotation when retracting or extending the unit.

Retraction of the nose unit is accomplished by the operation of two hydraulic actuating cylinders. The small actuating cylinder releases the spring latch which locks the unit in the extended position, allowing the main actuating cylinder to pull the unit up into the well. When fully retracted, a hook on the damper support plate is engaged by an automatic spring latch in the well, holding the unit in the retracted position.

When extending the unit, another small actuating cylinder releases the "retracted position" latch and the main actuating cylinder rotates the unit to the fully extended position, where the "extended position" latch engages a fitting on the forward side of the oleo.

It is possible to observe the position and operation of the nose wheel through a small window in the flooring of the pilots' compartment. There is a plugged hole through the compartment flooring at the forward end of the nose wheel well; a rod is supplied which, in an emergency, may be inserted through this hole far enough to touch the "extended position" latch. If the red collar on the rod extends above the top of the hole, the latch has not caught. Striking with the end of the rod will push the latch into place. This should be used if the indicator lights should not work or if there is any doubt as to the nose gear being locked down. In checking for the gear down position, it is important to observe through the sounding rod hole that the oleo strut is vertical and resting against the down bumper. Then insert the emergency lever through this hole and the hole in the down bumper bracket until it rests on the top of the down latch. When the latch is engaged the top end of the red collar on the emergency rod should be just even with the top of the hole. If the gear is not locked, try another hydraulic operation and if this does not lock the gear, proceed as per instructions for emergency lowering, 2.c. of this Section.

### d. Nose Gear Doors

Doors which cover the nose wheel well operate hydraulically in sequence with the nose wheel. In retracting the nose wheel, a sequence valve is opened at the end of the travel which allows fluid to go to the nose wheel door cylinder and close the doors. The sequence valve is located on the starboard side of the starboard auxiliary keel in such a position that a small extension on the main retracting crank engages the plunger in the valve. The valve has a snap action and is so adjusted that the nose gear is all the way up and latched before the valve is opened. Similarly, there is a valve on the door cylinder which allows fluid to go to the retracting cylinder when the gear is being lowered. This valve is closed at all times except when the doors are open.

### e. "Dual-Seal" Inner Tube (Ref. Figure 65)

A "Dual-Seal" inner tube is used in the nose-wheel tire. This inner tube differs from the conventional type in that the air for supporting the tire is confined in two compartments instead of one. The cover of the outer compartment, being made of rubber compound, inflates tightly against the inside of the tire and provides the resiliency required from a conventional tube. The inner compartment is made of two plies of rubberized fabric and a molded rubber flexible base.

If the tire is punctured, the outer tube will deflate. The inner compartment will then expand to seat tightly against the inside of the tire, and, being made of fabric, will bridge over the punctured section, retaining the necessary air pressure to keep the tire seated firmly on the rim and provide a rolling radius to permit landing.

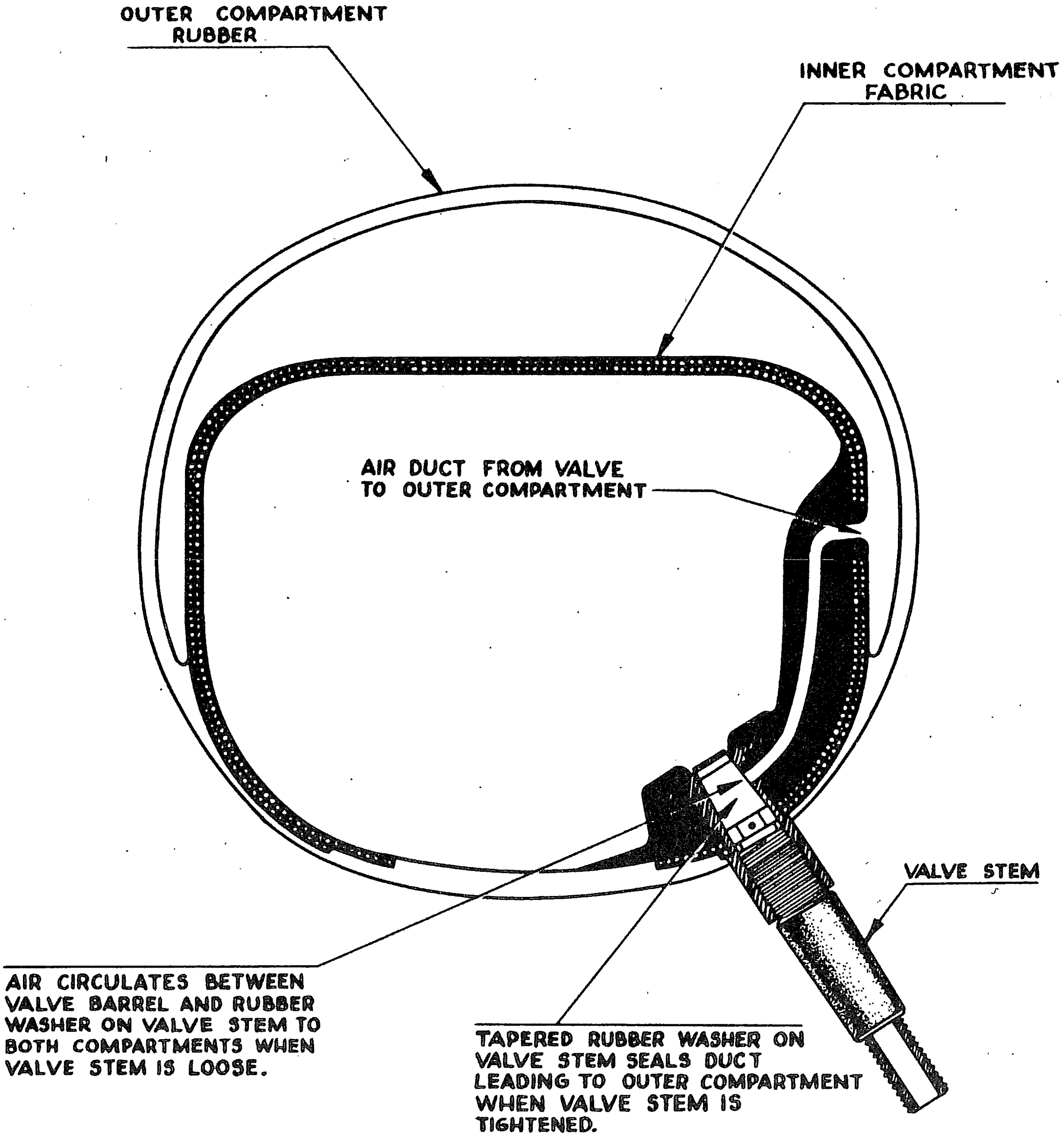

OUTER COMPARTMENT RUBBER
INNER COMPARTMENT FABRIC
AIR DUCT FROM VALVE TO OUTER COMPARTMENT
VALVE STEM
AIR CIRCULATES BETWEEN VALVE BARREL AND RUBBER WASHER ON VALVE STEM TO BOTH COMPARTMENTS WHEN VALVE STEM IS LOOSE.
TAPERED RUBBER WASHER ON VALVE STEM SEALS DUCT LEADING TO OUTER COMPARTMENT WHEN VALVE STEM IS TIGHTENED.

FIGURE 65
DUAL SEAL INNER TUBE
(CROSS SECTION)

Both compartments of the tube are inflated through a single valve of a special design. The main barrel of the valve is provided with an opening leading directly to an inner compartment. A rubber extension, containing an air duct molded onto the base, opens into the main barrel and is used for conveying air from the valve to and from the outer compartment. A rubber base attaches the valve to the interior compartment of the tube. In addition to the main valve barrel, there is a core housing, which carries the standard valve core, or plunger, and contains a cone-shaped rubber washer molded on a swivel base.

When the valve stem is screwed into the valve main barrel loosely (one to two threads) air introduced through it will flow into both compartments of the tube and circulate between them until the pressures in the two compartments become equalized.

When the valve stem is screwed down tightly into the valve main barrel, the tapered rubber plug molded onto its end seats against, and seals off, the duct leading to the outer compartment and locks the air in the inner compartment. This prevents escape of air from the inner compartment in case the outer compartment is punctured.

It is very important that equalized pressure be maintained in both compartments of tube at all times, and to accomplish this, it is necessary to loosen the core housing to the point where only one or two thread contacts remain, each time tubes are inflated or pressure checks are made.

Due to the abnormal stress to which a "Dual-Seal" tube will be subjected when a landing is made on a blown tire, the tube should never be re-used after landing with a cut or blown-out tire.

## 2. Operation

### a. Hydraulic Retraction and Extension

The selector valve, locking knob and nameplates for operation of the landing gear units are located below the pilots' instrument panel slightly to port of the airplane centerline. Complete operating instructions appear on the instruction plate. It will be noted that the selector handle can always be turned to the "DOWN" position without releasing the locking knob but that to turn the handle to the "UP" position requires pulling out the locking knob.

Three signal lights on the pilot's instrument panel indicate "WHEELS UP AND LOCKED", "NOSE DOOR LOCKED" and "WHEELS DOWN AND LOCKED". These lights work in conjunction with the warning and indicator switch light and the throttle closing circuit. When the pilot cuts the throttle for a landing all the indicator lights register showing "FLOAT WARNING LIGHT", "WHEELS UP AND LOCKED" and "NOSE DOOR LOCKED". "WHEELS UP AND LOCKED" and "NOSE DOOR LOCKED" will also register without cutting the throttle by throwing the indicator switch on the panel to the "INDICATE" position. This is provided as a convenience to the pilot in case he wishes to check the position of the landing gear, i.e., nose wheel and main landing gear. In either of the above operations when cruising, all the indicator lights except "WHEELS DOWN AND LOCKED" and "FLOAT WARNING LIGHT" will register. If the landing is to be made on land and the landing gear is lowered and locked the "WHEELS DOWN AND LOCKED" will register upon completion of landing gear extension, the "WHEELS UP AND LOCKED" and "NOSE DOOR LOCKED" will go out as soon as the gears leave their retracted position (The "FLOATS WARNING LIGHT" will remain on). If the landing is to be made on water, the floats warning lights will register if the throttles are cut; upon completion of the extension of the floats to the down position, the light will go off. The float warning light will not operate if the floats are fully extended to the down position and the throttles are cut. (The landing gear lights "WHEELS UP" and "NOSE DOOR LOCKED", will remain on). A second float warning light is located on the mechanic's instrument panel that works in conjunction with the above described float warning light.

### b. Emergency Extension of Main Landing Gear

The manual hydraulic system should be used in case of failure of the engine-driven pump. Proceed as follows:

(1) Rotate landing gear selector valve to "DOWN" position.

(2) Lower gear by building up hydraulic pressure with the emergency hydraulic hand pump provided.

In case of failure of the hydraulic system, the main landing gear may be lowered manually as follows:

(1) Rotate landing gear selector valve to "DOWN" position.

(2) Release the "UP" locks by pulling out and turning tee handles at main wheel wells 1/4 turn.

(3) Work gear down by rocking airplane approximately 14° to each side.

(4) Use the "DOWN LATCH" rod to straighten out the main support struts to put the gear into the "LATCHED DOWN" position.

This is done by inserting the emergency down-latching rod through the door and operating as follows:

(a) Engage the short end of the lever over the bolt provided on the auxiliary keel.
(b) Guide the outside end of the rod into the strut socket located just above the pivot point in the strut.
(c) Pushing firmly on the lever will straighten out the struts and the gear will lock down.

### c. Emergency Extension of Nose Wheel Gear

The manual hydraulic system, consisting of building up of hydraulic pressure by means of the hand pump, should be used in case of failure of the engine-driven pump. Refer above to 2.b. for procedure.

In case of failure of the hydraulic system, the nose wheel gear may be lowered manually as follows:

(1) Turn landing gear valve to "DOWN" position.

(2) Unlock doors by pushing door lock handle aft (Located on the starboard side, forward of bulkhead #1), thus releasing door lock pins.

(3) Insert hydraulic hand pump handle or emergency lever handle in aft end of starboard door torque tube, located aft of bulkhead #2, and push inboard (counter-clockwise), rotating torque tube and thus opening nose wheel well doors.

NOTE: In airplanes where the Radar Antennae have been installed, it will not be possible to use the emergency lever (furnished with the airplane) for emergency manual operation of the nose landing gear doors. However, the hydraulic hand pump handle may be successfully used for this purpose.

(4) Lock torque tube in "DOORS OPEN" position by swinging locking link inboard over lug on torque tube end fitting. Insert locking pin and retain with safety pin.

(5) Remove aft nose wheel cover plug and insert emergency lever through hole and strike end of up-latch sharply, thus unlatching landing gear.

(6) Attach emergency lever to torque tube between packing unit and jack fitting so that ratchet pawl fits into teeth of tack fitting. Using the lever as a ratchet, force the gear into the down position. To lock,use a slow, heavy push.

(7) Remove forward plug of wheel unit cover to examine down lock and use lever to determine if down latch is locked. If it is locked, the red collar on the lever will not extend above hole and oleo strut will be vertical and against down bumper. The red mark on the lever is being replaced by a metal collar. When the top of the collar is even with the hole, the down latch is locked.

CAUTION: (a) Before operating gear again, be certain to release the emergency door lock pin (See (4) above).

(b) Whenever packing gland on torque tube has been repacked, check to see that nut has been tightened enough to leave room to attach emergency lever (9/16").

d. The above procedure for the emergency hydraulic and manual lowering of the landing gear is based on the assumption of an actual failure of the power hydraulic system and should be followed for an actual emergency drop. However, if a check or practice emergency drop is to be made, it is necessary to first shut off the starboard engine and feather the propeller and then work the pressure out of the accumulator by operating the selector valve from the up to the down position and back again several times very rapidly. After this is done, proceed with the emergency drop as outlined in b. and c.

## 3. Service and Maintenance

### a. Main Landing Gear Shock Struts

Keep the strut filled to the level of the filler plug with mineral oil, Navy Spec. M-339-A; after filling, inflate it with air pressure until the red line on the piston tube is 2 inches maximum with light load or 1-1/2 inches minimum with full load from the end of the packing gland nut.

WARNING: Release the air in the strut before disassembling.

### b. Wheels and Brakes

#### (1) Wheels

Other than replacement of the bearing cups and refinishing of the wheels very little repair can be made. Where cracks appear in the casting and when damaged to the point of causing distortion, no attempt should be made to repair.

Bearing cups should be removed and replaced by either heating the wheel or cooling the bearing sufficiently to permit easy movement of the bearing. A differential temperature of approximately 100°F. between the wheel and bearing is necessary.

Never force a bearing either in or out of a wheel by means of hammering or pressing.

Portions of the wheel where the original finish has peeled or chipped should be retouched, using an aluminum pigmented lacquer, A.C. Spec. #3-158. One or two coats should be used depending upon the condition of the old paint. If it is necessary to completely refinish the surface, one coat of primer, A.C. Spec. 14080, followed by two coats of lacquer, Spec. 3-158, should be applied. It is essential that the surface be thoroughly cleaned before the application of the primer. The old finish should be removed by acetone or paint remover.

### (2) Brakes

Insufficient braking action is the result of the discs wearing and becoming thinner. As a further result, the piston travel is increased with corresponding greater fluid displacement. This calls for adjustment of disc clearance as follows. Remove wheel from brake unit and retaining nut lock screw from brake unit. Turn retaining and adjusting nut up tight. Then turn back until specified clearance of .120 ± .005" is available. Replace retaining nut lock screw and lock in next lock point.

When the discs are worn to such an extent that the adjusting nut cannot be tightened up to the specified clearance, a stationary steel disc should be inserted in the stack next to the adjusting nut and the brake then adjusted to the proper clearance. When discs are worn such that their condition calls for removal, replace with new set of discs. If discs are adjusted to provide less clearance than recommended, excessive heat from dragging may result.

Dirt in the system may cause brakes to drag or lock. When dirt is found, dismantle brake assemblies, flush lines, clean all pistons, piston seals, and piston rods; reassemble.

The bleeder plug is located near the top of the brake drum. To bleed, remove the small upper plug, attach the drain tube into the larger plug, loosen the larger plug. The larger plug acts as a valve, allowing fluid to escape when loosened, and stopping the escape when tightened. Bleed the fluid into a container; when the bubbles no longer appear in the fluid, tighten the larger plug, replace the small plug and return the fluid to the hydraulic reservoir in the starboard nacelle.

Dished or warped discs will change the clearance or adjustment and dragging brakes may result. In this case, remove discs, place on flat plate and tap until flat. If dished, tap on outer circumference; if warped, tap on inner circumference. If impossible to correct or if discs have become too badly worn from operating in this condition, replace with new discs.

### (3) Brake Reassembly

In reassembling a brake which has been completely disassembled for inspection or repair, first install the spring in the brake cylinder seal. This expander spring has a series of notches on both sides, those on one side being wider than on the other. The spring should be installed with lips up in the seal with the wide notches toward the inside and the narrow notches toward the outside. Locate the ends of the spring in the seal first, making certain that they meet but do not overlap.

All segments must be inside the lips of the seal. The mounting of the expander spring can be facilitated if the seal is lubricated with some brake fluid, thereby permitting the spring to adjust itself more easily.

Thoroughly clean the brake fluid cavity, cover with brake fluid and insert the seal and spring assembly lips inward, being careful to fit the seal into the cavity progressively so as not to cut the lips or force the spring from under the lips.

Special care must be taken to properly seal the brake to the axle torque plate and around the mounting bolts with a sealing compound such as Permatex No. 2, which is recommended. The old sealing compound should be cleaned away from the axle torque plate and the back of the brake and a new thin layer of Permatex spread evenly on the surfaces, as directed by the manufacturer of Permatex. Each bolt should be coated with Permatex when it is installed.

The wheel seal ring should be carefully resealed to the wheel with either Permatex No. 1 or No. 2, if it is ever found necessary to remove it for any reason.

The vent connection in the lower half of the brake may be a source of leakage. A swivel bolt connection is used for this fitting and it may become loosened, probably by vibration. An aluminum washer under this fitting, with Permatex No. 1, should make this watertight, but it may be necessary to safety wire the bolt to prevent loosening.

The hexagon screw heads exposed at the back of the brake in counterbored recesses should be sealed by filling the counterbore flush with Permatex No. 1.

After the seal is in place, locate the annular ring piston in the cylinder and install the piston rings. Place the insulator discs next to the piston and then locate the stationary and steel discs. There are two steel insulator discs, 19 rotating discs, 20 stationary discs. Insulator discs should be placed together next to the piston.

The heavy pressure plate should always be the first metal disc adjacent to the insulator disc. The next disc should always be a stationary steel disc, to be followed by alternate bronze and steel discs. The last disc in the stack next to the adjusting nut must always be a stationary steel disc.

After all discs are installed on the brake, screw the disc retaining and adjustment nut up tight. Then back off until a feeler gage can be inserted between the last disc and the adjustment nut and the proper clearance is obtained (.120 ± .005"). Back off the disc retaining and adjustment nut to the next lock position and safety in place.

In case a feeler gage is not available, another satisfactory method of adjusting disc clearance is as follows: Tighten adjustment nut up tight against the discs and then back off until the specified clearance is obtained on the basis that each complete turn of the adjustment nut gives .060" clearance.

### (4) General

Wheels and tires shall be checked for general condition and wear at every 30-hour interval.

Air pressure of 500 to 600 p.s.i. should be maintained in the lower side of the brake accumulator with no fluid in the accumulator.

The brakes on the main landing gear wheels are sealed against water and particular care must be given to lubrication and the detail servicing of the brakes.

The airplane can be handled on the ground by means of a towbar attached to the nose wheel axle. Care must be taken to fasten the safety cable of the bar to the snubbing fitting located on the keel at station #0.33. This cable indicates the turning limits of the nose wheel to prevent damage. Keep slack in this cable at all times when towing.

### c. Nose Wheel Gear Shock Struts

Directions for servicing the nose unit oleo are the same for the main unit oleo except that the red line on the piston tube should be 2-1/2 inches maximum with a light load or 2 inches minimum with a full load from the end of the packing gland nut.

### d. Nose Wheel Gear Shimmy Damper

#### (1) General

Note: The following instructions are to be used as a service guide for the shimmy damper. Nos. A-8098 and A-8099, A-8098A and A-8099A.

The damper unit is mounted on a bracket which is attached to the fixed or outer cylinder of the shock strut by means of three bolts.

The lever is attached to the serrated extension of the damper shaft at the lower end of the damper. The fit between the shaft and the lever is a light press. The lever is split and a bolt passes through it and a notch in the shaft. By means of a link, this lever is connected to the slip ring on the outer oleo cylinder. Pivot points have needle bearings. The slip ring is connected to the movable cylinder of the strut by a scissors. All joints from the movable cylinder to the damper must be maintained tight and free from lost motion.

When the lever is assembled to the damper shaft, a careful check should be made to assure that the steering stops contact before the oscillating vanes of the damper shaft strike the stationary vanes.

#### (2) Adjustment

There are two types of the valve adjusting mechanism, namely, external and internal. Similarly, the requirements for valve adjustment vary, namely, when the damper has the external type, the adjustment is made in taxiing tests and when the damper has the internal type, the adjustment for normal conditions of use has been made by the manufacturer. The following instructions should be used for determination of the valve adjustment and for readjustment if such becomes necessary.

(a) (External adjustment). Remove the dust cover from the point of adjustment which is on the end of the shaft below the lever. This will reveal an adjusting needle which contacts raised portions on the end of the shaft for stops.

(b) (Internal adjustment). Remove the weld of nut-to-shaft by filing. Unscrew the nut. This will reveal a screwdriver slot with an arrow on its end which is in line with a chisel mark on the end of the shaft. This mark lies between the letters "o" and "s" on the face of the shaft end and represents the valve setting as determined by the manufacturer. Clockwise rotation of the valve toward "s" closes the valve: counter-clockwise rotation toward "o" opens it.

(c) (External adjustment). With a very narrow open end wrench, loosen the lock nut between the adjusting needle and the slotted gland nut. Turn the adjusting needle, which closes clockwise and opens counter-clockwise, to the half-closed position (end of needle midway between its stops).

(d) When taxiing the airplane, if the wheel has a tendency to shimmy, the adjusting needle must be turned toward the closed position, that is, clockwise by increments of 1/32 inch at a time until shimmy is eliminated.

While this valve setting is adequate to stop shimmy during normal taxiing, additional adjustment may be necessary to prevent it when maximum decelerating loads are imposed on the nose wheel. Make several taxiing runs at a speed of approximately 70 miles per hour and during each run apply the brakes with increasingly greater pressure until full deceleration is reached. If shimmy occurs, close the valve further until there is no indication of it when the maximum braking effort is applied.

It is desirable to use the damper with its valve open as far as possible so that damping is effected with a minimum stiffening of steering and with a minimum damper pressure.

When the satisfactory adjustment is made, the adjusting elements should be capped as follows, depending upon the type:

(e) (External adjustment). Retighten the lock nut. Return the dust cover to its position and lockwire it in place.

(f) (Internal adjustment). Replace the cap nut. If possible, tack weld in place at one point.

### (3) Service

The shimmy damper requires twenty (20) hour service. At the end of this period, if the unit is functioning properly, an oil level check only is required.

There are two types of the fluid level indicating mechanism, namely, gaging and indicating.

(a) (Gaging type). Remove the screw plug from the top cover, exposing the replenishing plunger guide.

(b) (Gaging type). Insert a 1/8 inch diameter rod centrally into this hole, contacting the bottom of the hole in the guide. When the damper is properly filled at 60° to 80° F., the distance between the bottom of the guide post hole and the top of the cover should be approximately 1 47/64 inch. If it is more, the unit needs more fluid.

(c) (Indicating type). When the damper is properly filled at 60° to 80°F., the needle at the top of the unit should extend 3/8 inch above the cover, If it is less, the unit needs more fluid. If it is below 9/32 inch, refilling is imperative.

(d) The filler fitting is located on the side of the damper. To refill, remove the lockwire and the protecting cap, exposing an ordinary lubricator fitting. Use Houdaille Fluid No. L-1404 for refilling; if this is not available, use castor oil, Specification AN-JJJ-0-316 (formerly 2-8-B). Select a CLEAN lubricator hand gun with the proper nozzle.

(e) Force fluid into the fitting until the damper is correctly filled as explained in "b". Avoid overfilling because this will force the replenishing chamber plunger assembly against its upward stop and bend it out of shape with resulting failure in operation.

(f) If the filler fitting (I-5743) leaks, replace it with the new type (A-9755) and proceed with the refilling operation.

(g) In the event that the oil level was low or that the filler fitting was removed for replacement, air may have been trapped in the unit during the refilling operation. Air pockets are removed by oscillating the lever. Either of two methods can be used as follows:

1. Jack the front end of the airplane until the wheel clears the ground. Attach a tow bar to the fork and oscillate back and forth as far as possible (approximately 25 times).

2. Disconnect the link from the damper lever. Slip a piece of pipe over the lever and pump in each direction as far as possible, (120 degrees oscillation).

When the pumping has been completed, check for removal of air pockets by quick pull-and-push movement on the lever by hand when the lever is in the mid-position of its travel. The presence of pockets can be detected as free, unrestrained movement.

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(h) Replace the cap over the filler fitting and lockwire in place. Replace the screw plug in the top cover for the gaging type.

### (4) Disassembly from Strut

Removal of the damper from the oleo strut should not be necessary except for replacement of the unit in case of an accident, or for replacement of the replenishing piston assembly. It can be removed as follows:

(a) Remove the dust cover and the snap ring from the end of the shaft below the lever.

(b) Remove the bolt from the split lever. Remove the lever from the shaft.

(c) Remove the three bolts which hold the damper to the mounting bracket.

(d) For major repair of the damper itself, it should be returned to the manufacturer or to the nearest Air Base.

### (5) Replacement of Replenishing Piston Assembly

The necessity of frequent filling of the damper may indicate that the replenishing piston assembly is leaking. This condition can be discovered quickly by observing the presence of oil on the 1/8 inch diameter rod which is used for gaging the fluid level (see (3)-(c). To replace the piston assembly (A-5296) for Gaging type, or A-8801 for Indicating type).

(a) Remove the top cover, cover gasket and piston actuating springs. Then, remove the filler fitting in the side of the damper body and pull out the replenishing piston assembly.

(b) Insert the new piston assembly into the cylinder. EXTRAORDINARY CAUTION must be taken to see that the inner lip of the piston packing is not folded, turned, or sheared off in the assembly.

(c) Bolt the damper to a plate and clamp the plate in a vise so that the damper lies in a horizontal position with the filler hole uppermost.

(d) Reassemble the piston springs, top cover, and new cover gasket I-5832).

(e) Pour fluid into the open filler hole slowly to expel all air.

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(f) Reinstall the filler fitting. If it is damaged, replace it with the new type (A-9755). Fill to the proper level as explained above.

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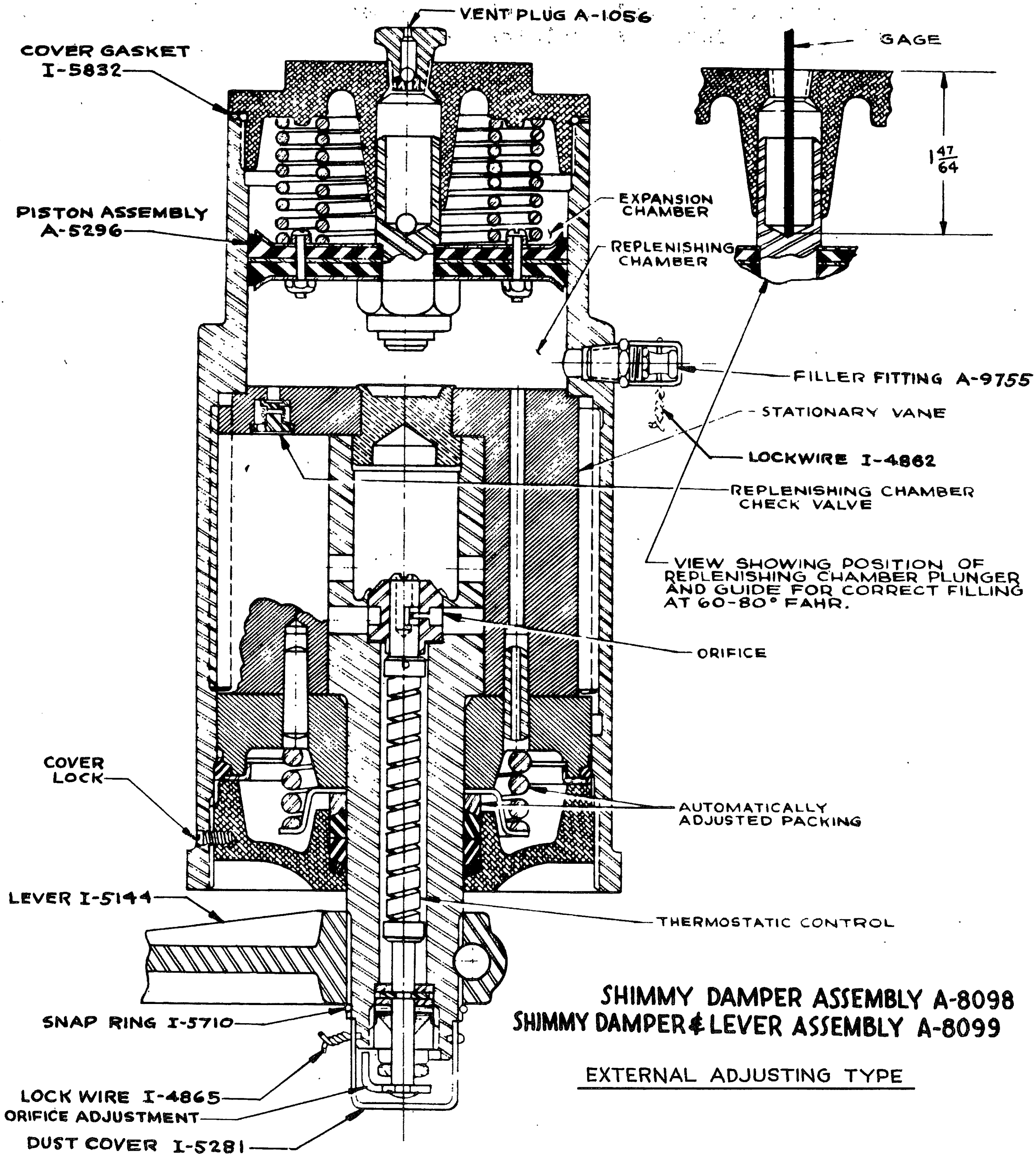

SHIMMY DAMPER ASSEMBLY A-8098
SHIMMY DAMPER & LEVER ASSEMBLY A-8099

EXTERNAL ADJUSTING TYPE

FIGURE 66
HOUDAILLE SHIMMY DAMPER

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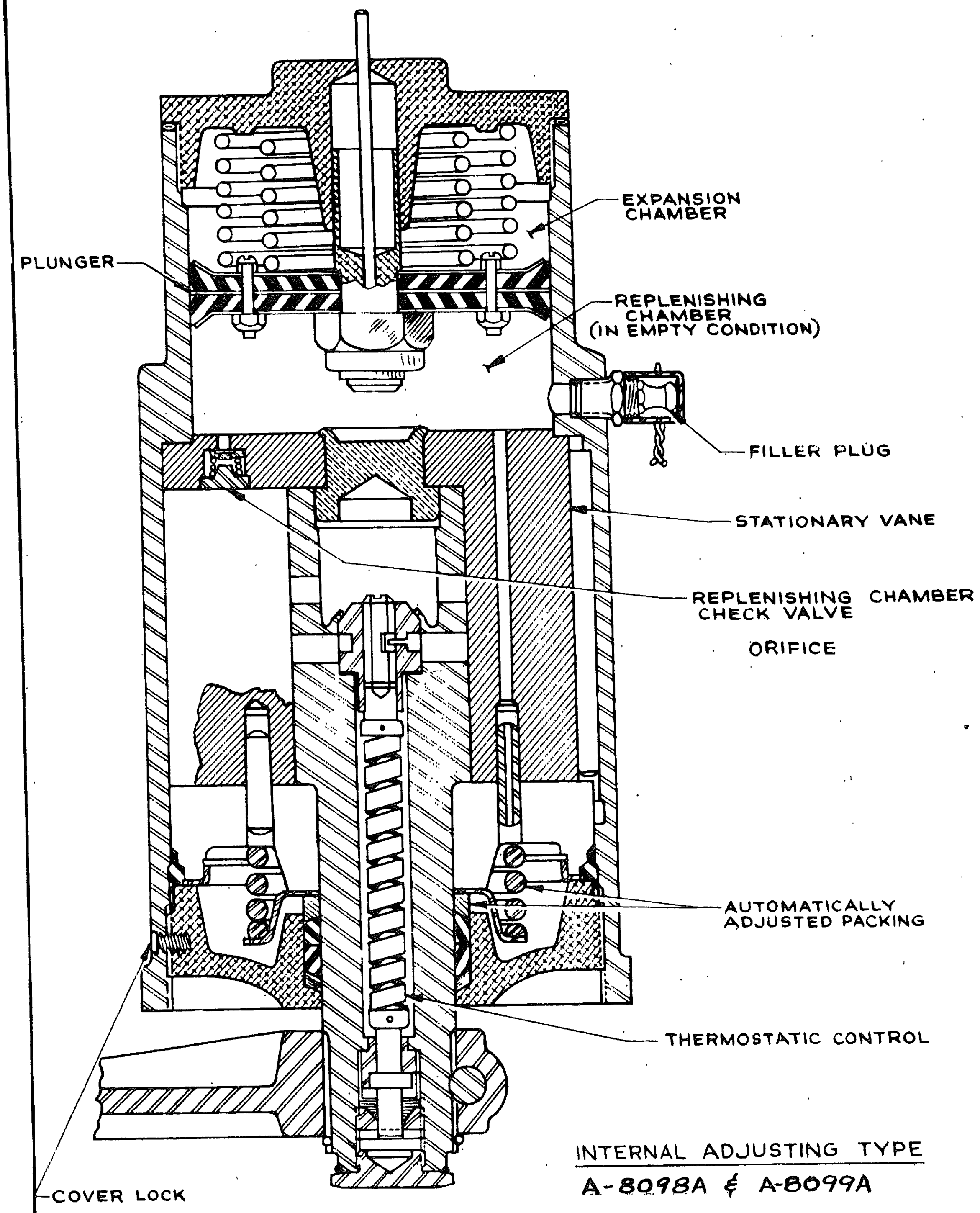
EXPANSION CHAMBER
PLUNGER
REPLENISHING CHAMBER (IN EMPTY CONDITION)
FILLER PLUG
STATIONARY VANE
REPLENISHING CHAMBER CHECK VALVE
ORIFICE
AUTOMATICALLY ADJUSTED PACKING
THERMOSTATIC CONTROL
COVER LOCK

INTERNAL ADJUSTING TYPE
A-8098A & A-8099A

FIGURE 66 A
**HOUDAILLE SHIMMY DAMPER**

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### e. To Mount Nose Wheel Tire

Pry lock ring out of wheel with screwdriver; remove tire retaining rim and lay wheel on the floor with the fixed rim side down. If the tire is being changed, it is necessary to deflate the tire on the wheel before the lock ring and the rim can be removed. No soap is to be used in assembly. To assemble the tire and tube, work completely deflated tube into the tire, making sure that the red balance marks on the tire and tube are in line. Inflate the tube to fill it out and force the tire and tube over the hub onto the wheel with the hands. It is desirable to substitute an ordinary metal stem (TR76 or equivalent)(Schrader 7791) for the dual seal valve stem at this point, but it is not absolutely necessary. Deflate tube sufficiently to work stem through valve hole in the wheel and carefully line up with the hole. The valve stub will not seat completely in the hole until the tube is inflated. Replace the tire retaining rim, force lock ring into place and carefully inflate the tire to the proper pressure.

### f. To Demount Nose Wheel Tire

If the tire is being changed due to a puncture or blowout, the valve stem will have been sheared off at the rubber shear connection and be pulled inside the wheel but the inner safety chamber will still be sealed, making it necessary to puncture the tube. This is all right as the tube must be replaced. If the tire is not punctured, remove the "Dual-Seal" valve complete, thus deflating the tube and reverse the mounting procedure.

Check tire pressure frequently to overcome tendency of "Dual-Seal" valve to shear off by the tire creeping due to underinflation. Creeping may be checked by painting a stripe on the wheel rim and tire and observing shift after use. If any appreciable shift is noted, deflate the tire and realign the tube with the valve hole in the wheel.

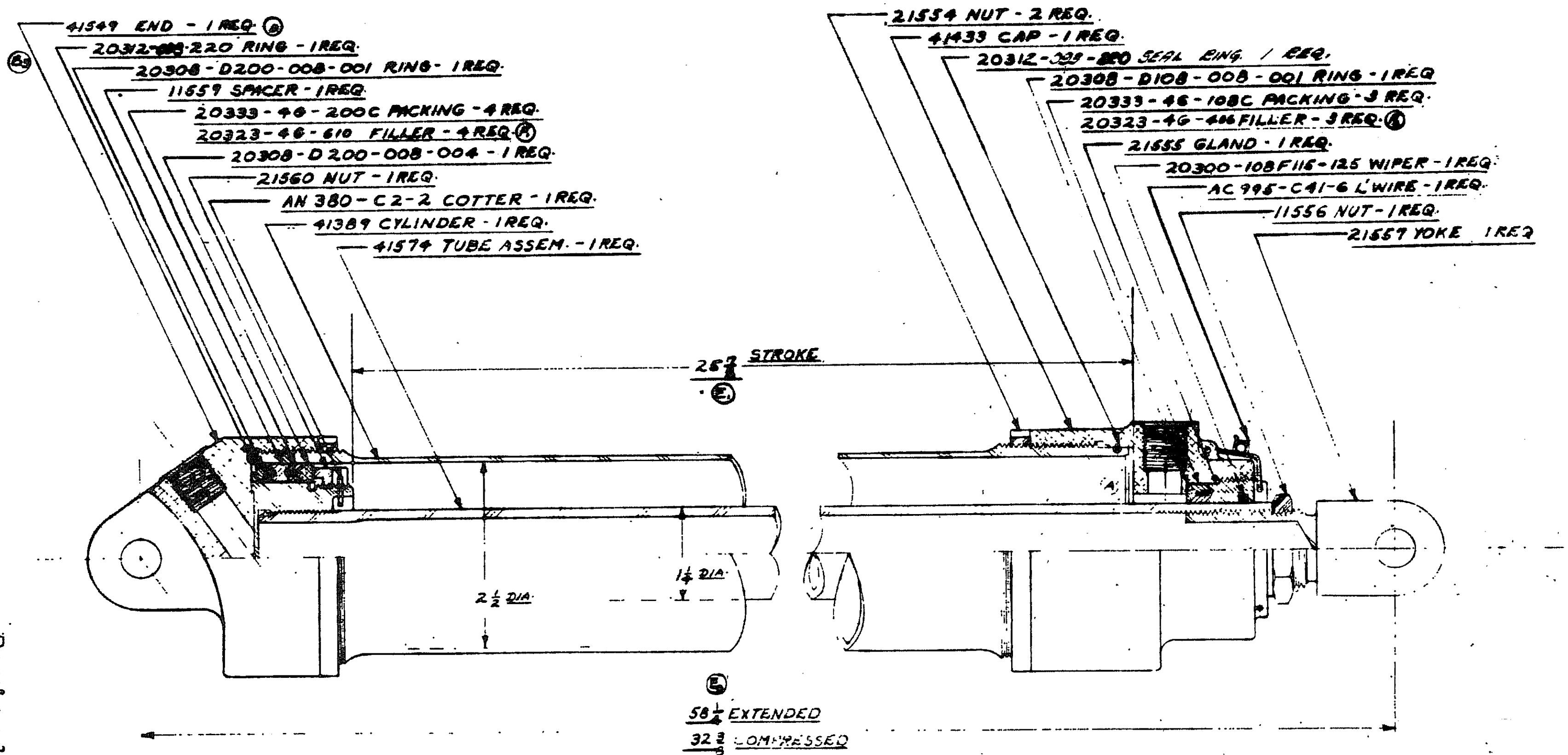
41549 END - 1 REQ. Ⓑ
Ⓑ3
20312-~~[illegible]~~-220 RING - 1 REQ.
20308 - D200 - 008 - 001 RING - 1 REQ.
11559 SPACER - 1 REQ.
20333 - 46 - 200C PACKING - 4 REQ.
20323 - 46 - 610 FILLER - 4 REQ. Ⓐ
20308 - D 200 - 008 - 004 - 1 REQ.
21560 NUT - 1 REQ.
AN 380 - C2 - 2 COTTER - 1 REQ.
41389 CYLINDER - 1 REQ.
41574 TUBE ASSEM. - 1 REQ.
21554 NUT - 2 REQ.
41433 CAP - 1 REQ.
20312 - 329 - 220 SEAL RING. 1 REQ.
20308 - D108 - 008 - 001 RING - 1 REQ
20333 - 46 - 108C PACKING - 3 REQ.
20323 - 46 - 406 FILLER - 3 REQ. Ⓐ
21555 GLAND - 1 REQ.
20300 - 108F116 - 125 WIPER - 1 REQ.
AC 995 - C41 - 6 L'WIRE - 1 REQ.
11556 NUT - 1 REQ.
21557 YOKE 1 REQ
25⅞ STROKE
(E1)
A
2½ DIA.
1¼ DIA.
Ⓔ
58¼ EXTENDED
32⅜ COMPRESSED

FIGURE 66 A

MAIN LANDING GEAR CYLINDER

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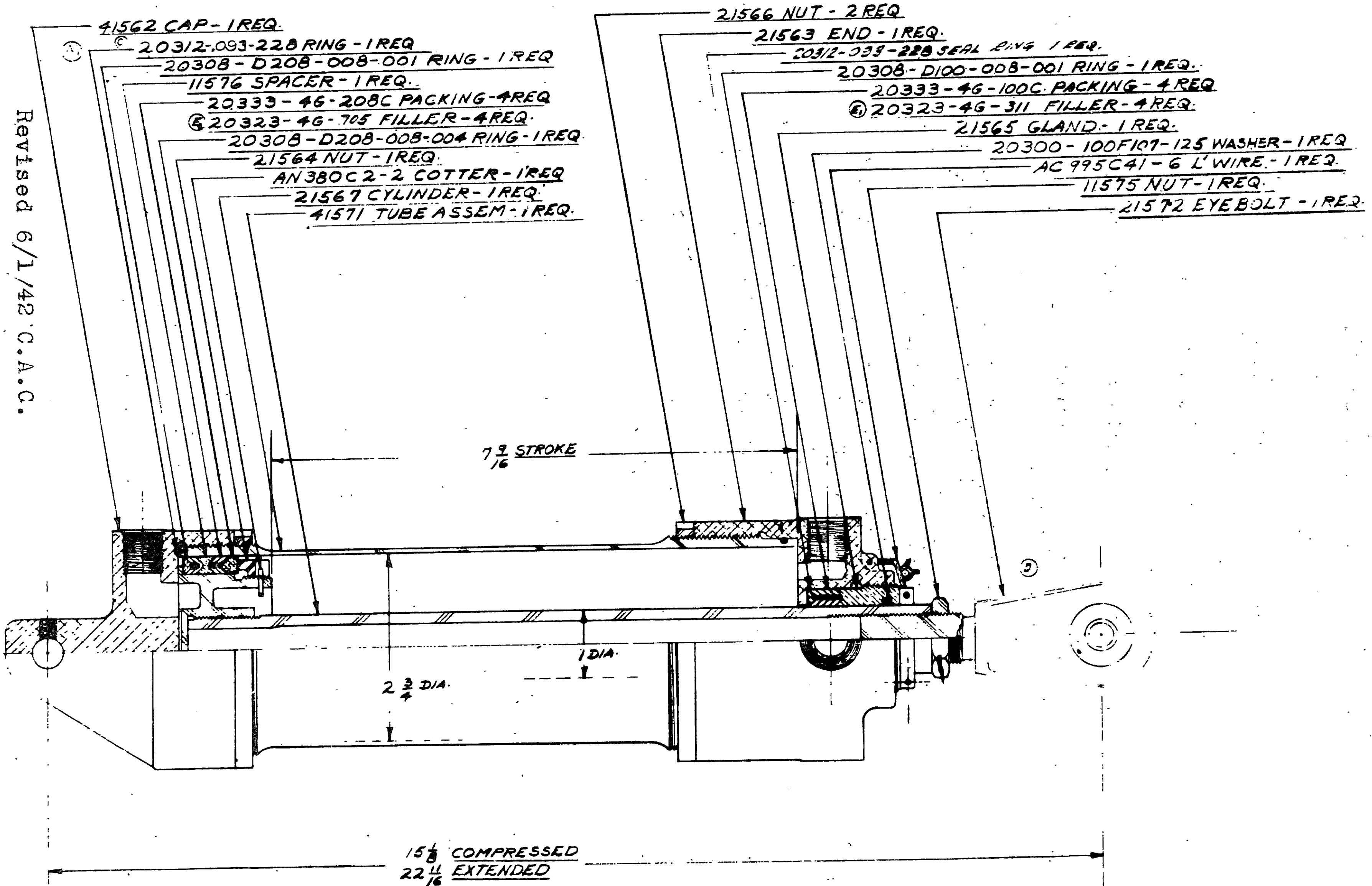

41562 CAP - 1 REQ.
20312-093-228 RING - 1 REQ
20308 - D208 - 008 - 001 RING - 1 REQ
11576 SPACER - 1 REQ.
20333 - 4G - 208C PACKING - 4 REQ
20323 - 4G - 705 FILLER - 4 REQ.
20308 - D208 - 008 - 004 RING - 1 REQ
21564 NUT - 1 REQ.
AN380C2-2 COTTER - 1 REQ
21567 CYLINDER - 1 REQ.
41571 TUBE ASSEM - 1 REQ.
21566 NUT - 2 REQ
21563 END - 1 REQ.
20312-039-228 SEAL RING 1 REQ.
20308 - D100 - 008 - 001 RING - 1 REQ.
20333 - 4G - 100C PACKING - 4 REQ
20323 - 4G - 311 FILLER - 4 REQ.
21565 GLAND - 1 REQ.
20300 - 100F107 - 125 WASHER - 1 REQ
AC 995C41 - 6 L' WIRE - 1 REQ.
11575 NUT - 1 REQ.
21572 EYEBOLT - 1 REQ.
7 9/16 STROKE
1 DIA.
2 3/4 DIA.
15 5/8 COMPRESSED
22 11/16 EXTENDED

FIGURE 66 B

# NOSE LANDING GEAR CYLINDER

## g. Main Wheel and Nose Wheel Actuating Cylinders

### (1) Inspection

20 Hour - A general inspection should be made as follows:

Inspect for leakage around piston rod and end caps.

Check locknuts and safety wire for tightness.

To correct above troubles, the following procedure should be used:

If leakage occurs around piston packing, lockwire should be removed and packing nut tightened. If leakage still persists, packing should be replaced.

If leakage occurs at piston end cap seal, the seal ring should be replaced.

If leakage occurs at end cap, locknut should be loosened and end cap tightened. If leakage still occurs, replace ring seal at end of cylinder.

All new rings and packing should be thoroughly soaked in Sperry oil before installation.

### (2) Disassembly:

Loosen piston rod end locknut and remove rod end.

Remove piston rod packing nut.

Loosen piston rod end cap locknut and remove piston rod end cap.

Remove packing rings from end cap, being careful not to injure packing while passing threads.

Remove piston from cylinder by pulling on piston rod or cautiously applying air pressure at oil port in cylinder end cap.

Remove piston packing nut and packing, being careful not to injure packing.

Loosen cylinder end cap lock nut and remove cylinder end cap.

(3) Inspection:

All parts should be carefully inspected, paying particular attention to the following:

Inspect all packing and ring seals for cuts, cracks, or scratches.

Check cylinder wall and piston rod for scratches.

Check packing nut for internal scratches.

Check piston packing spacer and adapter rings for scratches.

(4) Reconditioning:

All parts should be reconditioned as follows:

Replace all damaged or badly-worn packing and seal rings after soaking thoroughly in Sperry oil.

Buff piston rod and cylinder walls to a high polish to remove scratches.

Buff packing nut and piston packing adapters and spacer to remove scratches.

(5) Assembly:

Assembly closely follows disassembly:

Parts should be assembled in accordance with Figures 66A & 66B.

All parts should be thoroughly cleaned with solvent before assembly with the exception of packing and seals, which are soaked in Sperry oil. Wipe all parts clean before assembly. Use ample approved thread lubrication on threads.

Install piston packing and tighten nut securely. Back off on nut until packing may be rotated with a firm hand motion, and locknut in place with cotter pin.

Place seal ring in position in the groove at end of cylinder, making sure ring is not twisted.

Carefully install cylinder end cap and tighten down very tightly against seal ring. Tighten locknut.

Insert piston in cylinder, being careful to avoid injuring packing.

Install seal ring on cylinder, being sure it is not twisted.

Screw on piston end cap until it bottoms against cylinder end and then back off to give proper stroke adjustment and port alignment. Tighten locknut.

Insert piston rod packing, using a packing ram or similar tool. Care should be exercised so as not to injure packing when passing threads. A piece of shim stock formed into a cylinder ao as to cover threads will prevent injury to packing from this source.

Install packing nut and tighten firmly, then back off about 1/4 or 1/2 turn and lock in position with safety wire.

Replace piston rod end eyebolt and lock in position with locknut.

(6) Test:

Apply 2500 p.s.i. at each port individually and check for leakage.

External leakage shall not exceed 2 drops in 12 hours.
Internal leakage shall not exceed 10 drops in 1 hour.

Packing friction should not exceed 25 p.s.i. applied at large end.

## 4. Lubrication

### a. General

Reliable and satisfactory operation of the landing gear is entirely dependent upon complete and proper lubrication. An amphibian airplane is subject to service conditions which tend to dissolve and wash out lubricants, especially when operating from salt water. For this reason too much stress cannot be placed upon thorough and frequent lubrication.

Use a high pressure grease gun and check that the lubricant flows entirely around the bearings. Whenever possible, lubricate the plane when cradled or on a beaching gear, so that the weight of the plane is taken off the bearings, thus permitting good penetration.

For lubrication instructions on the main landing gear, the nose wheel landing gear and the nose wheel retracting mechanism, refer to Figures 63, 64, and 68 respectively. Service experience has shown that particular care must be given on the nose gear to the down latch and main retracting pivot bearings and on the main gear to the vee strut and main strut bearings.

### b. Brakes

The threads on the anchor bracket casting should be lubricated with a coating of ALCOA thread lubricant to insure easy operation of the brake adjusting unit.

It is essential that the seal ring which prevents the entrance of water into the brake be packed with grease at all times. Alemite gun grease of a medium viscosity or New York and New Jersey Lubricating Company's K-36 Non-Fluid Grease is recommended. Replenish the grease in the seal rings through the two lubricators provided; daily, if the plane is used in the water, and weekly if operation is from land.

### c. Wheels

Wheels are provided with Timken bearings and should be lubricated carefully. The bearings should be lubricated approximately every 100 hours. Remove the wheel from the axle and thoroughly clean the bearings by washing in gasoline. The bearings should be repacked with a small quantity of grease (N.Y. and N.J. Lubricating Company's K-36 Non-Fluid Grease). The nose wheel bearings are greased through a lubricator fitting and the whole interior cavity is filled to exclude water.

## 5. Inspection

Seepage of water into the brake cavity will cause corrosion and in cold weather, freezing of the brakes. On all airplanes, but the first few, a drainage plug is provided to the brake cavity. This may be removed to check for any leakage. If any evidence of leakage is found all the water seals should be inspected to determine their tightness. This includes the main water seal, the alclad washers under the torque bolts, the gasket compound used around the torque plate, torque plate bolts and between the sealing drum and wheel, the gasket under the cover cup at the outer end of the axle, the vent hose and connection and the bolts holding the brake anchor keys. Permatex #2 is the gasketing compound mentioned above and upon reassembly the old compound must be cleaned off and replaced with new.

Inspect nose wheel down-latch locking springs once a week for proper operation. Broken springs should be replaced.

## 6. Removal

The airplane shall be jacked and cradled as given in Part M

of this section.

a. To remove the main landing gear, proceed as follows:

(1) Remove wheel.

CAUTION: Never lay the wheel and tire assembly on the deck or floor with the brake side down. The wheel seal ring extends slightly beyond the tire line and since it is of rather light gage material, it may be damaged so that the seals do not function properly.

(2) Support lower V-strut so that it will not fall against the hull.

(3) Remove shock strut from strut assembly by disconnecting the following attachments: Main strut to shock strut, upper V-strut to shock strut, lower V-strut to shock strut.

(4) Disconnect the following attachments: Main strut to hull fitting, upper V-strut legs to hull fittings, lower V-strut legs to hull fittings, retracting piston to fitting on forward leg of upper V-strut.

b. To remove the nose wheel gear, proceed as follows:

(1) Back out packing nut on starboard cross tube. Remove retraction fitting from starboard cross tube.

(2) Remove bolts attaching cross tubes and diagonal tubes to shock strut.

(3) Withdraw shock strut from strut assembly.

(4) Withdraw cross tubes from keel sockets.

## 7. Installation and Replacements

To assemble either main landing gear or nose wheel gear, reverse the procedure given above in part 6.

In assembly of the main landing gear actuating jack, the jack must be adjusted at the rod end to have an overtravel of 1/4" ± 1/32" when the gear is down and locked. Similarly, on the nose gear, the actuating jack must have a minimum overtravel of 1/8" with the gear down and locked. A minimum clearance in the fore and aft direction of .030" must be checked between the down latch pin and the down latch when engaged.

Required clearances between latch actuating jacks and levers or piston:

| | MAIN GEAR | NOSE GEAR |
|---|---|---|
| UP LATCH . . . . . . . | 3/32 | 1/32 |
| DOWN LATCH . . . . | 1/8 | 1/32 |

These clearances will provide correct overtravel to latches to give positive locking.

## 8. General Service Instructions

When replacing wheels, keep the axle nut drawn as tight as permissible in order that the wheel will revolve on its bearings as true as possible. If the bearing adjustment is too loose, the wheel will sag slightly on the tapered bearings and this will allow the wheel seal ring to run slightly eccentric with respect to the brake seal and may allow the entrance of water past the synthetic rubber seals. Instances have been found where the axle nut was at least one-half turn too loose.

If it is necessary to remove and replace a brake on the axle, special care must be taken to properly seal the brake to the axle torque plate and around the mounting bolts with a sealing compound such as Permatex No. 2, which is recommended. The old sealing compound should be cleaned away from the axle torque plate and the back of the brake and a new thin layer of Permatex spread evenly on the surfaces, as directed by the manufacturer of Permatex. Each bolt should be coated with Permatex when it is installed.

Special care must be taken to see that the hub cap and gasket are properly assembled over the end of the axle, as water can easily enter at this point. Originally, the gasket used under the hub cap was of a rubber compound which deteriorated rapidly, but it has recently been changed to a synthetic compound, which resists the action of grease. At assembly of the hub cap, the gasket should be coated with a gasket cement, such as "Bostic", made by the B. B. Chemical Co., Cambridge and South Middleton, Mass. Care should be taken that the hub cap screws are not too tight, as it is possible to squeeze the gasket out between the screws, if overdone.

With regard to loss of air pressure in the 5" accumulator, this accumulator should be inspected at least once a week. The methods for checking the air pressure in the 5" and 10" accumulator are as follows:

Place the airplane upon jacks and operate selector valve handle back and forth a few times to relieve the 5" accumulator of oil. When oil is being relieved in the accumualtor, watch pressure gage on pilot's instrument panel, and the last definite pressure shown on this gage, before it falls back to zero, is the amount of air pressure in the 5" accumulator.

When checking the air pressure in the 10" accumulator, the fluid again must be relieved. To relieve fluid, operate the brakes back and forth constantly for approximately 10 or 15 minutes, or until no further foot reaction is felt. After oil is relieved, attach a booster pump or other air charging device incorporating a pressure gage, to the air valve on the bottom of the accumulator and read the air pressure on the gage which is installed in the pressure line leading to the 10" accumulator.

Should the air valve core be removed from either accumulator at any time, it cannot be re-used. It must be replaced with either a Schrader #1939 or Dill #100-DBB type core. Replacement of removed valve cores with the correct new core is considered very important for maintaining the proper operation of the accumulator.

NOTE: Use the correct valve cores for airplane accumulators. AUTOMOBILE TIRE VALVE CORES ARE NOT SATISFACTORY FOR THIS PURPOSE.

Low oil level in reservoir -- The oil reservoir should be checked regularly, at least once a week, to make certain that the oil level is not below the red line shown on the reservoir gage, under conditions described on the nameplate attached to the reservoir.

Adding oil to reservoir -- On inspection of the oil reservoir, the oil level may appear to be low. The next check should be to inspect both the 5" and 10" accumulators for air pressure before adding oil. The reason for this inspection is that, if accumulators are not charged, they will fill up with oil from the reservoir. This condition, of course, would show the reservoir to be low. If reservoir were filled and then accumulators relieved of oil for checking the air pressure, the reservoir would overflow .

Lack of oil pressure in the hydraulic systems -- If it appears that there is a lack of oil pressure in the system, although the gear can be operated with the hand pump, this may be due to the fact that the reservoir is divided into three sections:

(1) The top for foaming space
(2) The middle for system operation
(3) The bottom for hand pump emergency operation.

Therefore, if the accumulators have insufficient air pressure and fill up with oil from the reservoir, it is possible that enough oil would not be left in the middle or system section of the reservoir to operate the gear through a complete cycle. However, the hand pump could complete a cycle because it draws its oil from the bottom of the reservoir and the filling of the accumulators with oil would not affect the oil supply to the hand pump.

The foregoing points are very important and further point out the necessity for periodic checks of air pressure in the accumulators. If the hydraulic pressure gage shows a pressure between 200 and 300 p.s.i. when starting to operate the gear, check the following items in the order given:

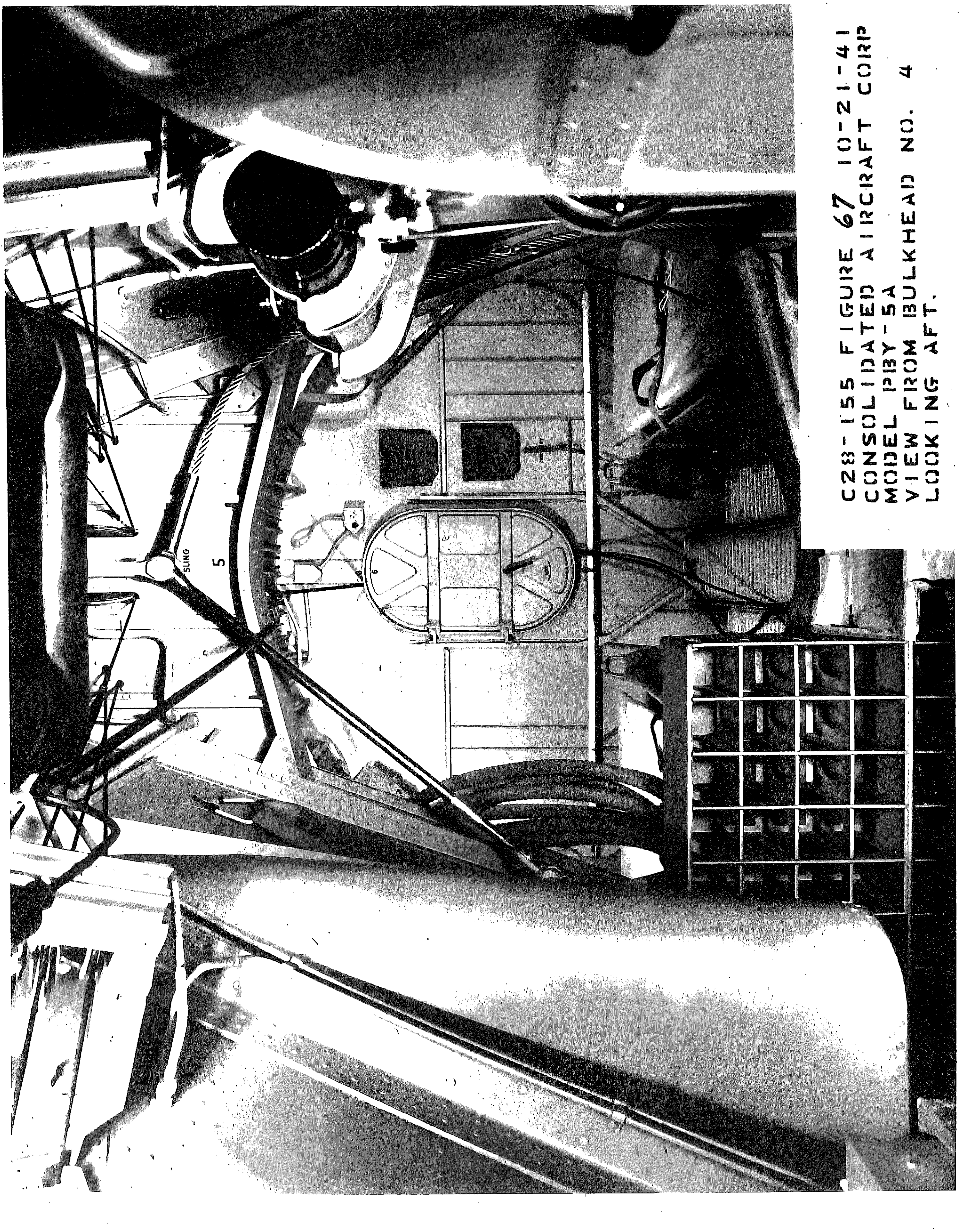
(1) Pressure Relief Valve - should by-pass at 1250 p.s.i.

(2) Unloading Valve - inspect to determine that it is opening and closing at the correct pressures. (Unload at approximately 1000 pounds and load at approximately 850 pounds.)

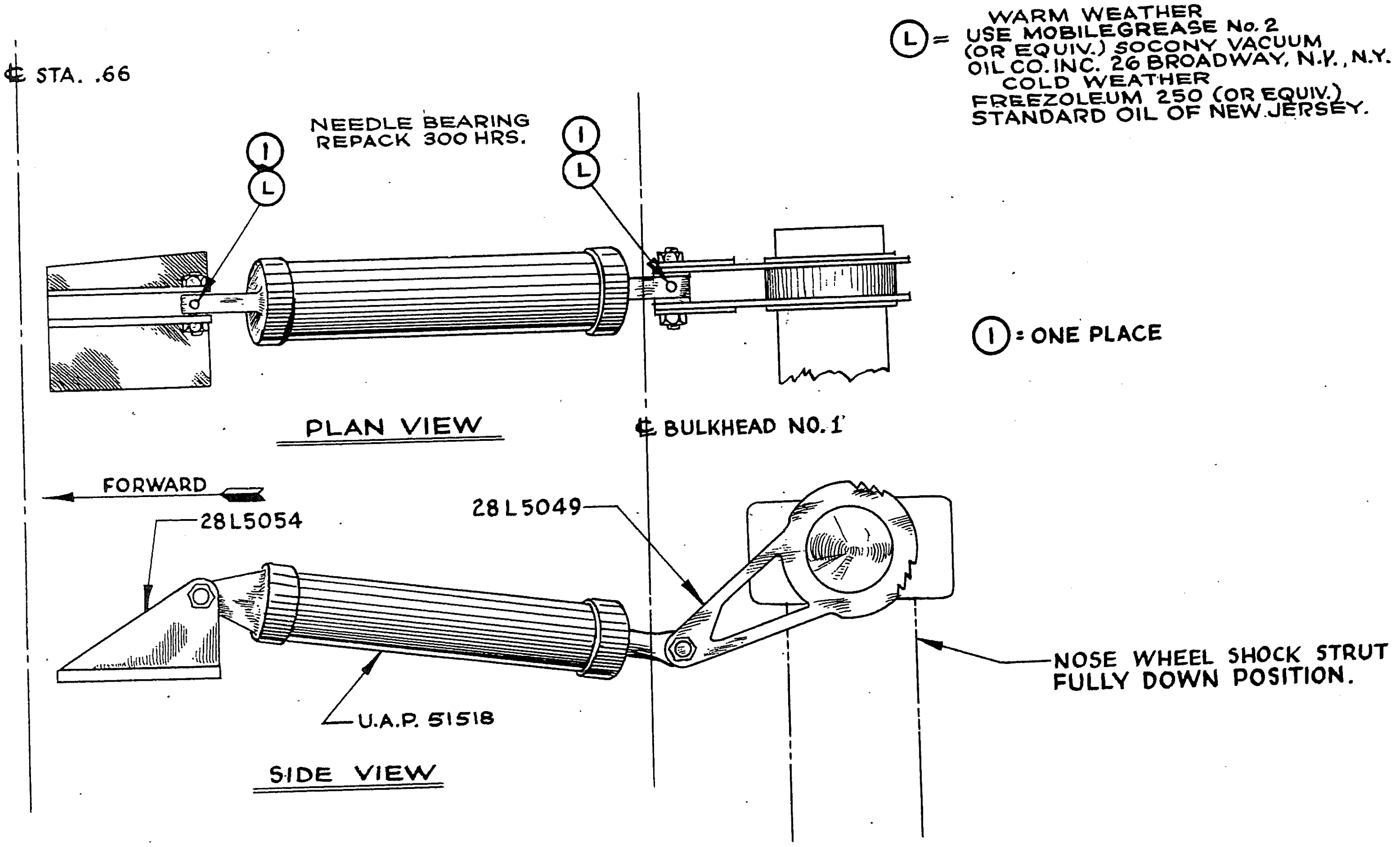
(3) Air Pressure to Accumulators

(4) Oil Level in Reservoir

The correct operation of all units of the Hydraulic and Sperry systems, their possible troubles, and corrective measures and test and inspection of valves, is covered in the Erection and Maintenance Manual, Section IV, Part J.



C28-155 FIGURE 67 10-21-41
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A
VIEW FROM BULKHEAD NO. 4
LOOKING AFT.



REFER TO C.A.C. DWG. 28L5004

FIGURE 68
NOSE WHEEL RETRACTING MECHANISM LUBRICATION

## L. Surface Controls (Ref. C.A.C. Dwg. 28C5700)

### 1. Description

#### a. Cockpit Controls (Ref. Figure 80)

The control system consists of an aileron and elevator control of the wheel and yoke type, and the rudder control, which is the adjustable pedal type. These controls are dual providing for a pilot and co-pilot seated side by side in the cockpit. Both the pilot's and co-pilot's positions are furnished with an individual set of rudder pedals which are connected by a cable and chain idler system as shown in Figure 71. The elevator control yoke, which carries the pilot's and co-pilot's control wheels, runs across the cockpit. The wheels are interconnected for aileron control by a chain loop running over a sprocket at each wheel shaft. The chains are connected on the top side with a cable and on the bottom side with two links and a turnbuckle completing the loop.

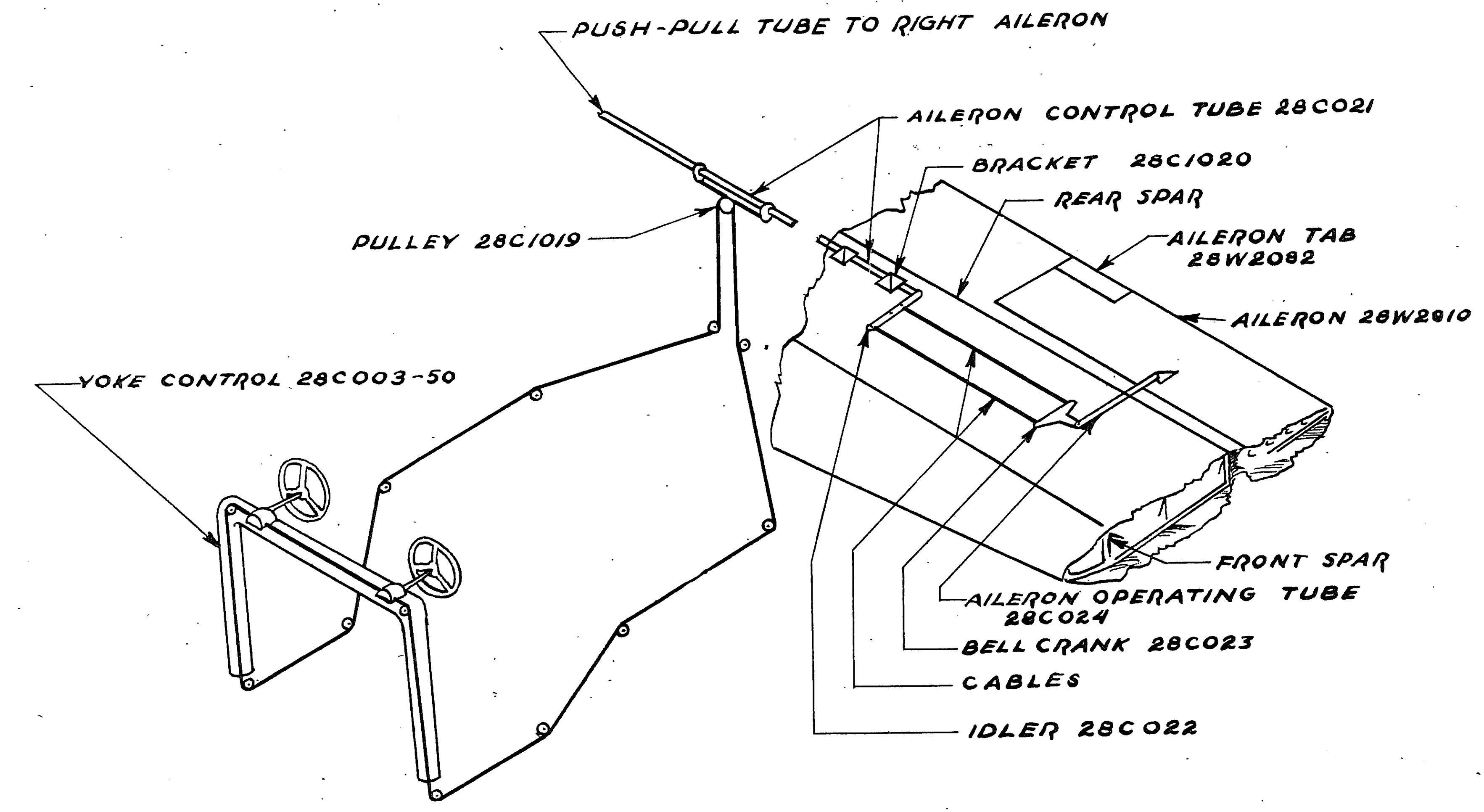
#### b. Control System (Ref. Figures 69, 70, 71 )

Aileron cables, one on each side, lead from the link on the lower side of the wheel loop, over pulleys in the yoke, aft through the hull, and up aft of bulkhead #5.0, through the superstructure to a transverse push-pull rod in the wing center section. This push-pull rod connects to an idler bellcrank connected by cables to the bellcrank which actuates the aileron operating tube.

Elevator control cables, two on each side, run from the mast arms of the control yoke over pulleys through the hull to a bellcrank located in the lower fin structure. The bellcrank is connected to the elevator horn by the adjustable push-pull tube.

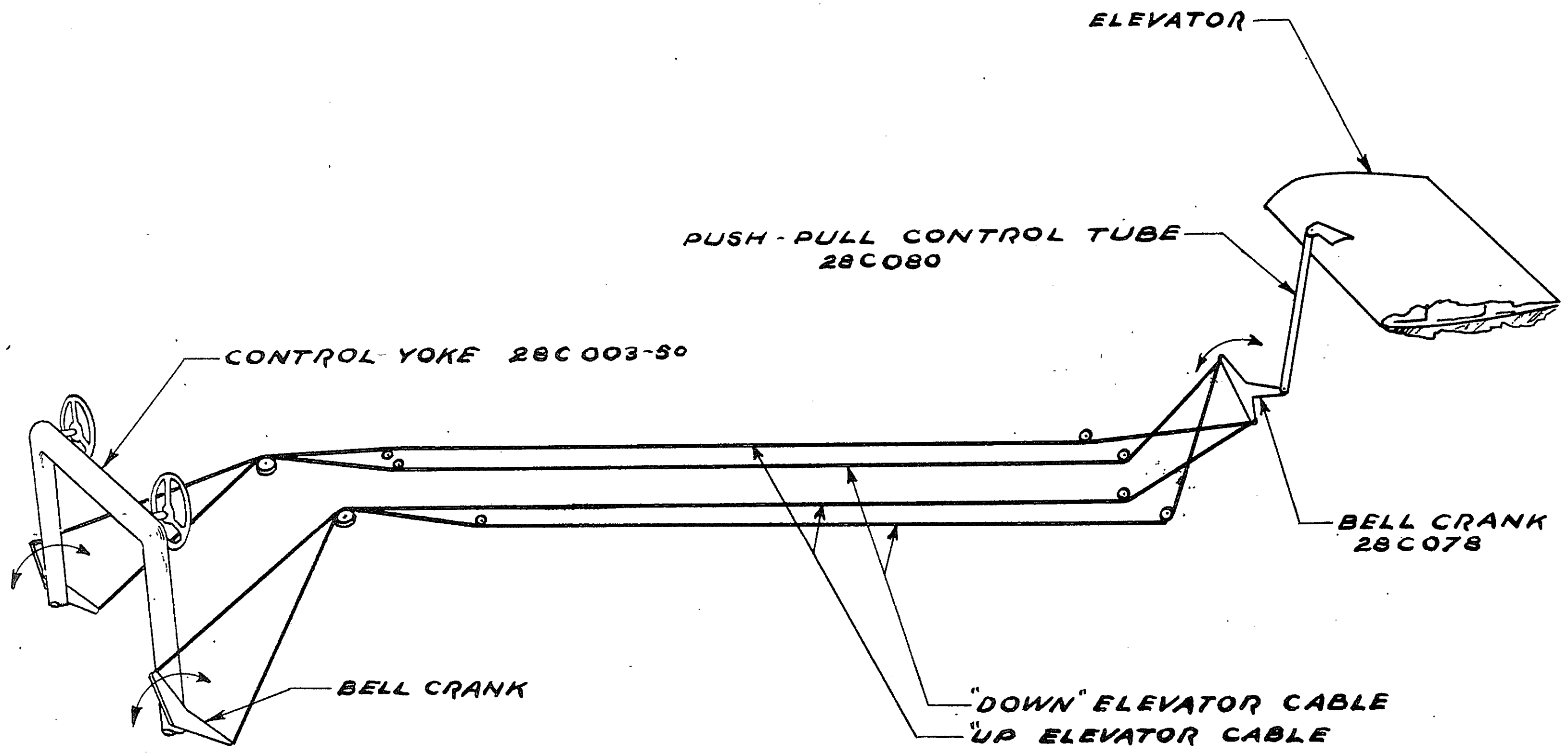
The rudder cables, one on each side, run aft from a mast arm on each outboard pedal, over pulleys through the hull. They connect directly to a horn on each side of the rudder.

Provision is made to lock the surface controls from the cockpit. The rudder may be locked in the neutral position by a locking lever. The lock in the empennage structure, consists of a plunger which slides into a socket in the leading edge of the rudder. The plunger is housed in the integral lower-fin structure and is actuated through cables and bellcrank by a lever located at the pilot's left hand. To lock the rudder, the locking lever should be pushed out and forward according to the directions on the instruction plate located at the lever on the port side of the hull, just outboard from the pilots' seat.



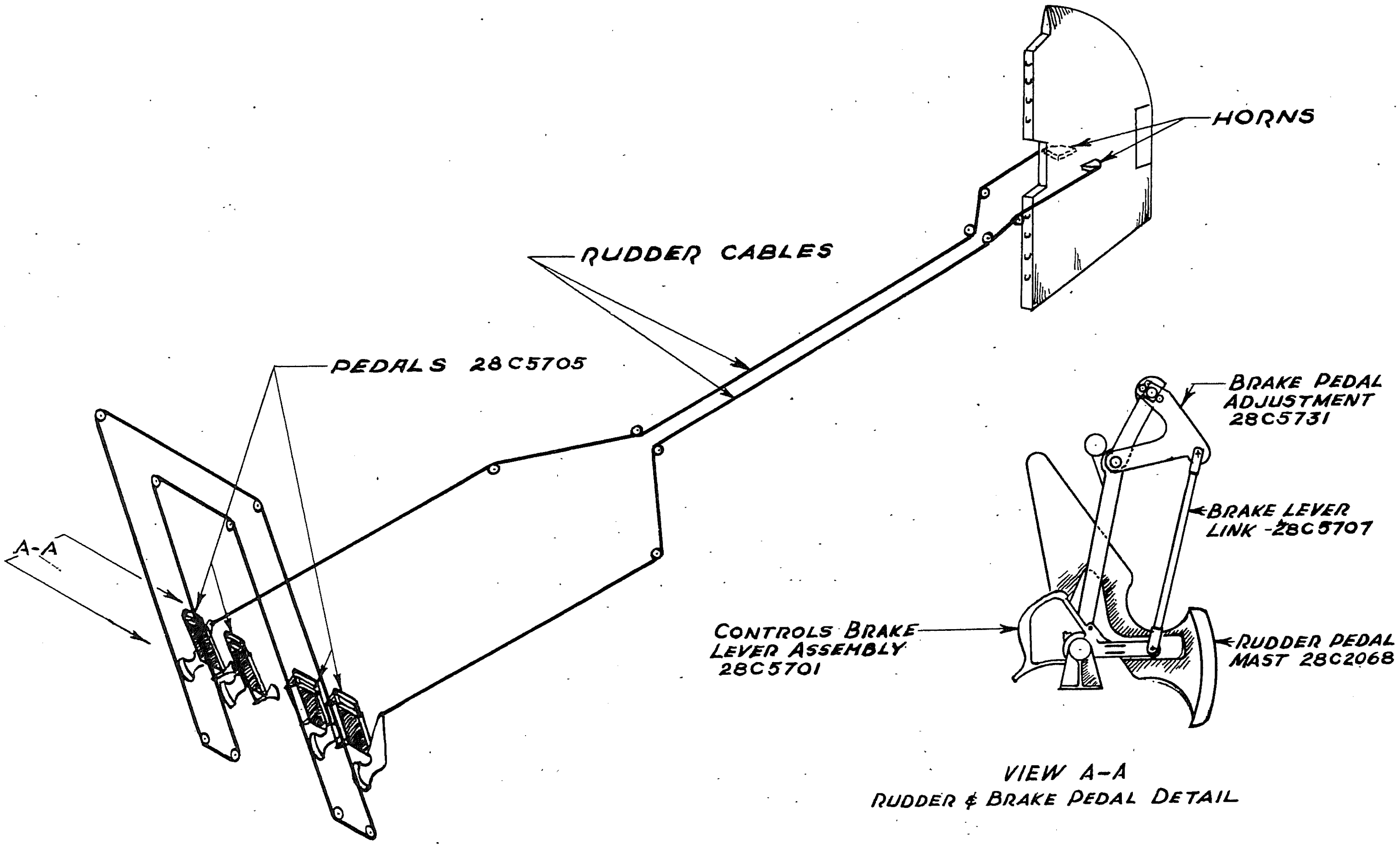
REFER TO C.A.C. DWG 28C5700

FIGURE 69
AILERON CONTROLS SYSTEM



REFER TO C.A.C. DWG. 28C5700

FIGURE 70
ELEVATOR CONTROLS SYSTEM


HORNS
RUDDER CABLES
PEDALS 28C5705
A-A
BRAKE PEDAL ADJUSTMENT 28C5731
BRAKE LEVER LINK -28C5707
CONTROLS BRAKE LEVER ASSEMBLY 28C5701
RUDDER PEDAL MAST 28C2068

VIEW A-A
RUDDER & BRAKE PEDAL DETAIL

REFER TO C.A.C. DWG. 28C5700

FIGURE 71
RUDDER CONTROLS SYSTEM

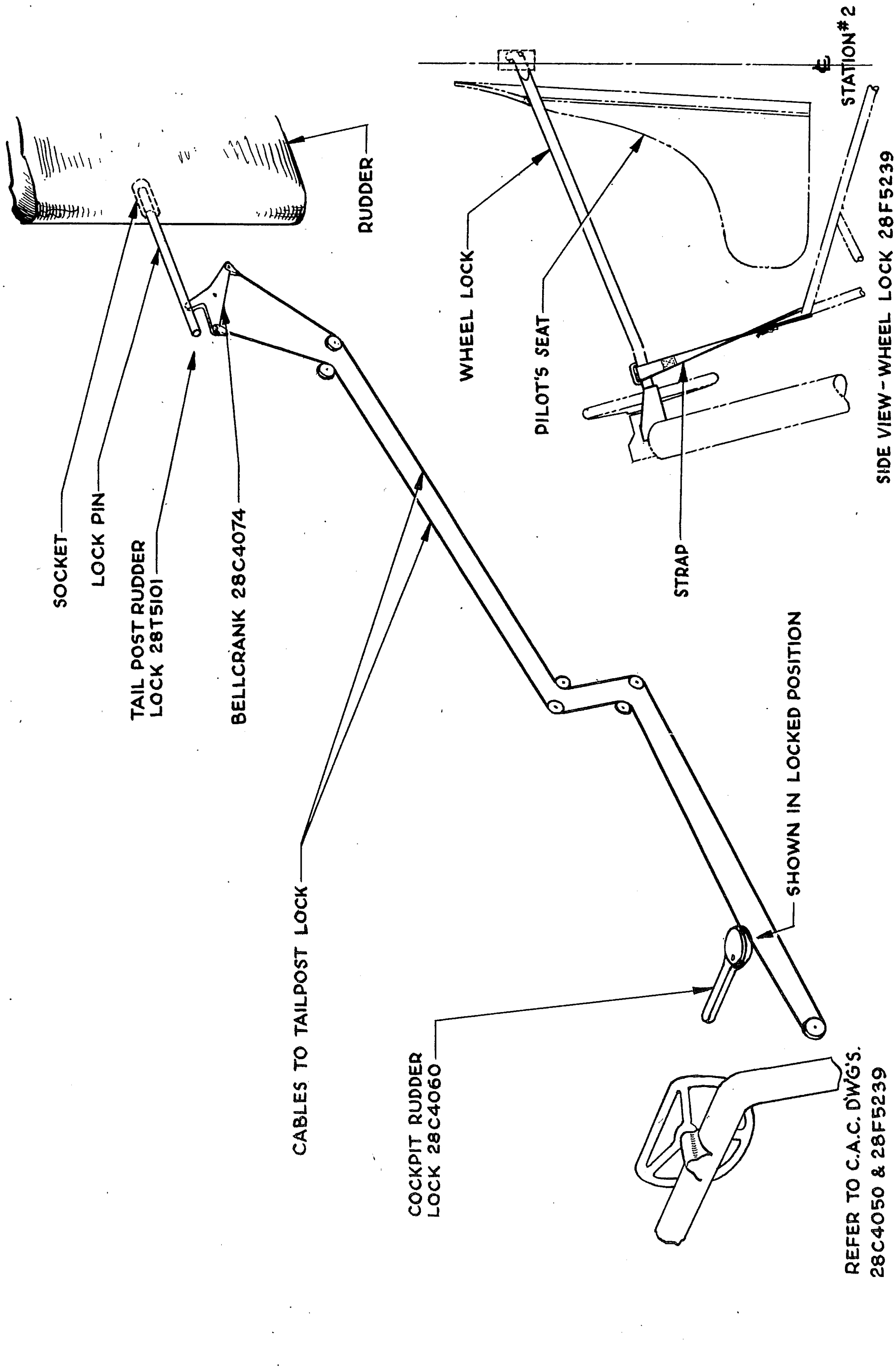
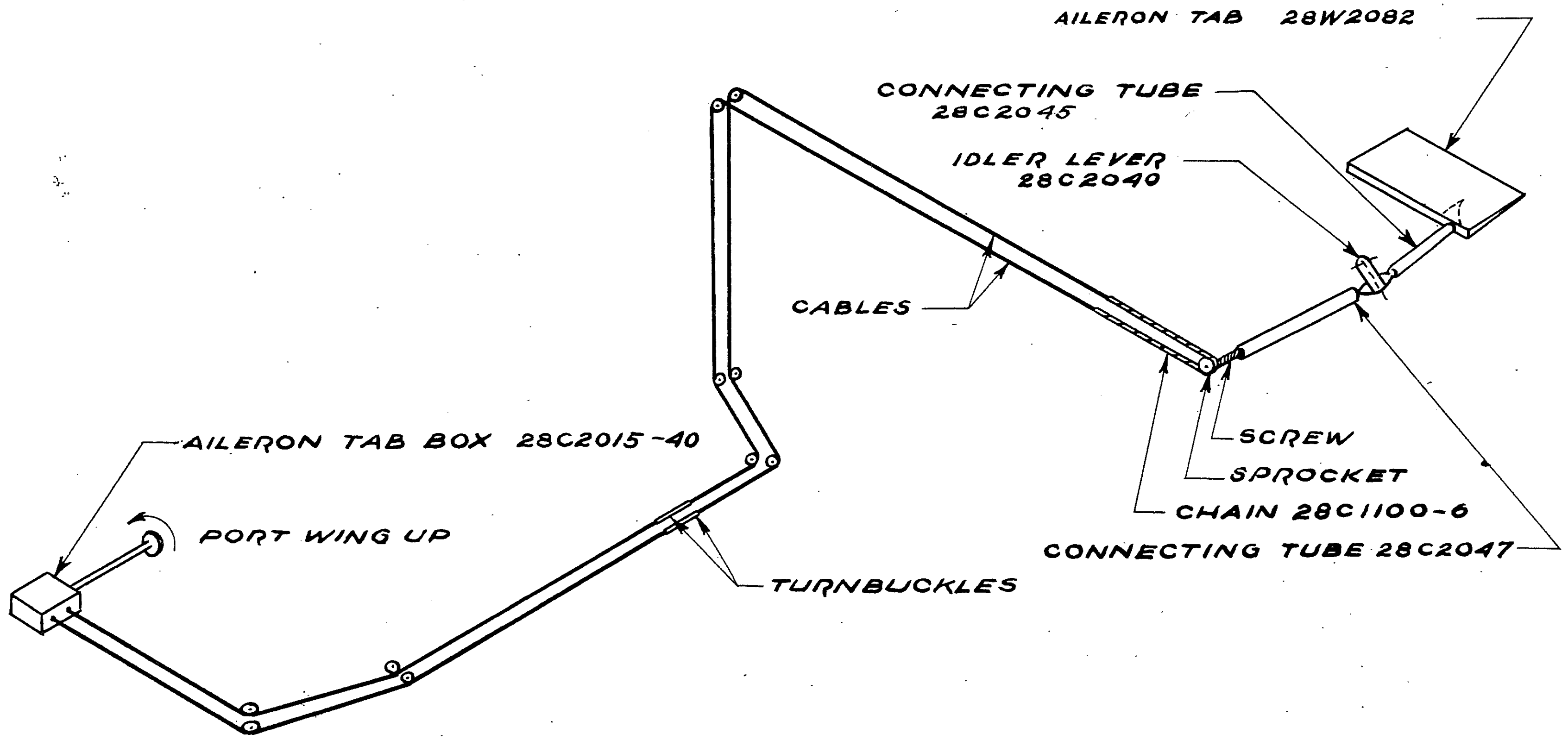
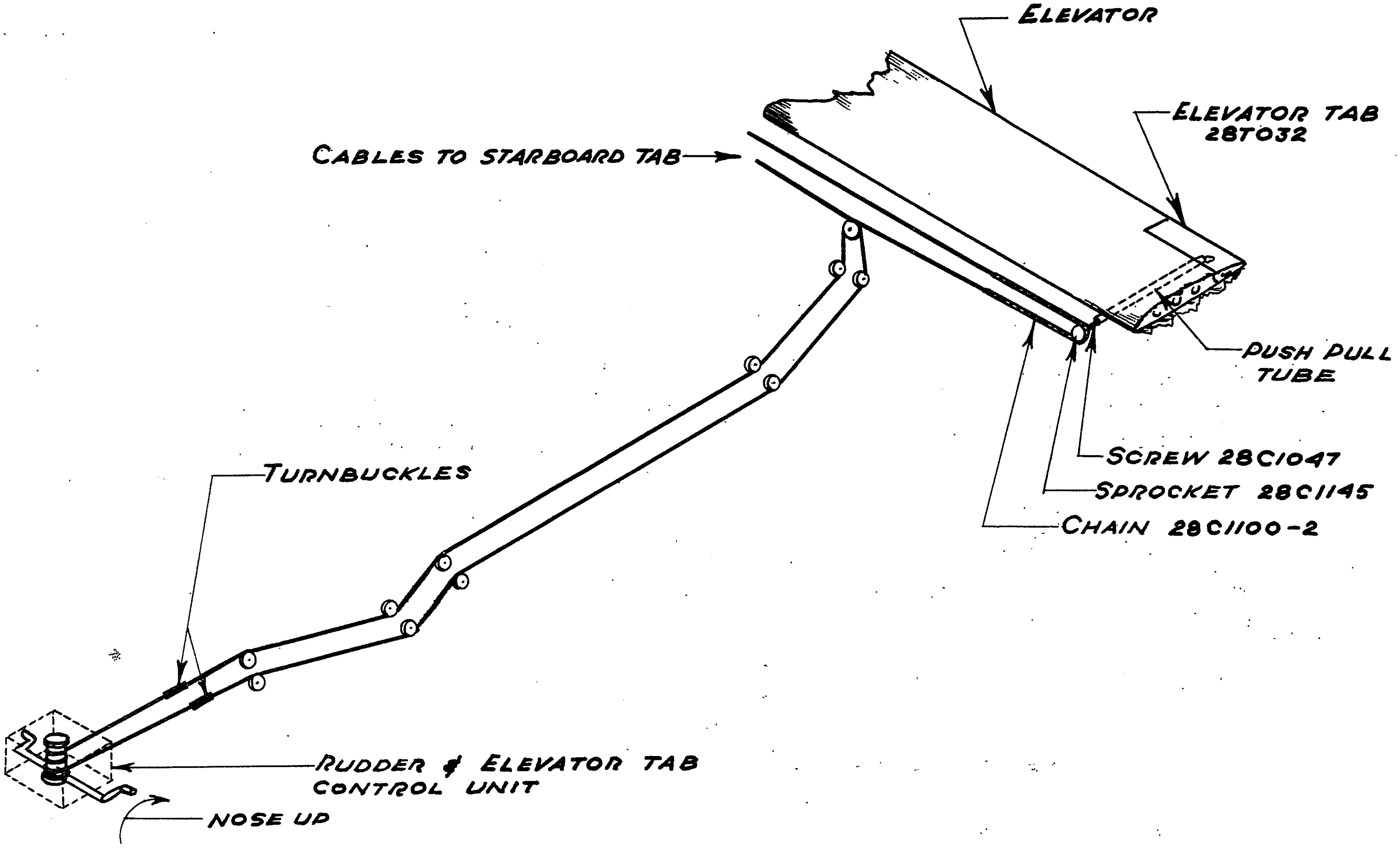

RUDDER
SOCKET
LOCK PIN
TAIL POST RUDDER LOCK 28T5101
BELLCRANK 28C4074
CABLES TO TAILPOST LOCK
COCKPIT RUDDER LOCK 28C4060
REFER TO C.A.C. DWG'S. 28C4050 & 28F5239
SHOWN IN LOCKED POSITION
WHEEL LOCK
PILOT'S SEAT
STRAP
℄ STATION #2
SIDE VIEW-WHEEL LOCK 28F5239

FIGURE 72
CONTROL LOCK SYSTEM



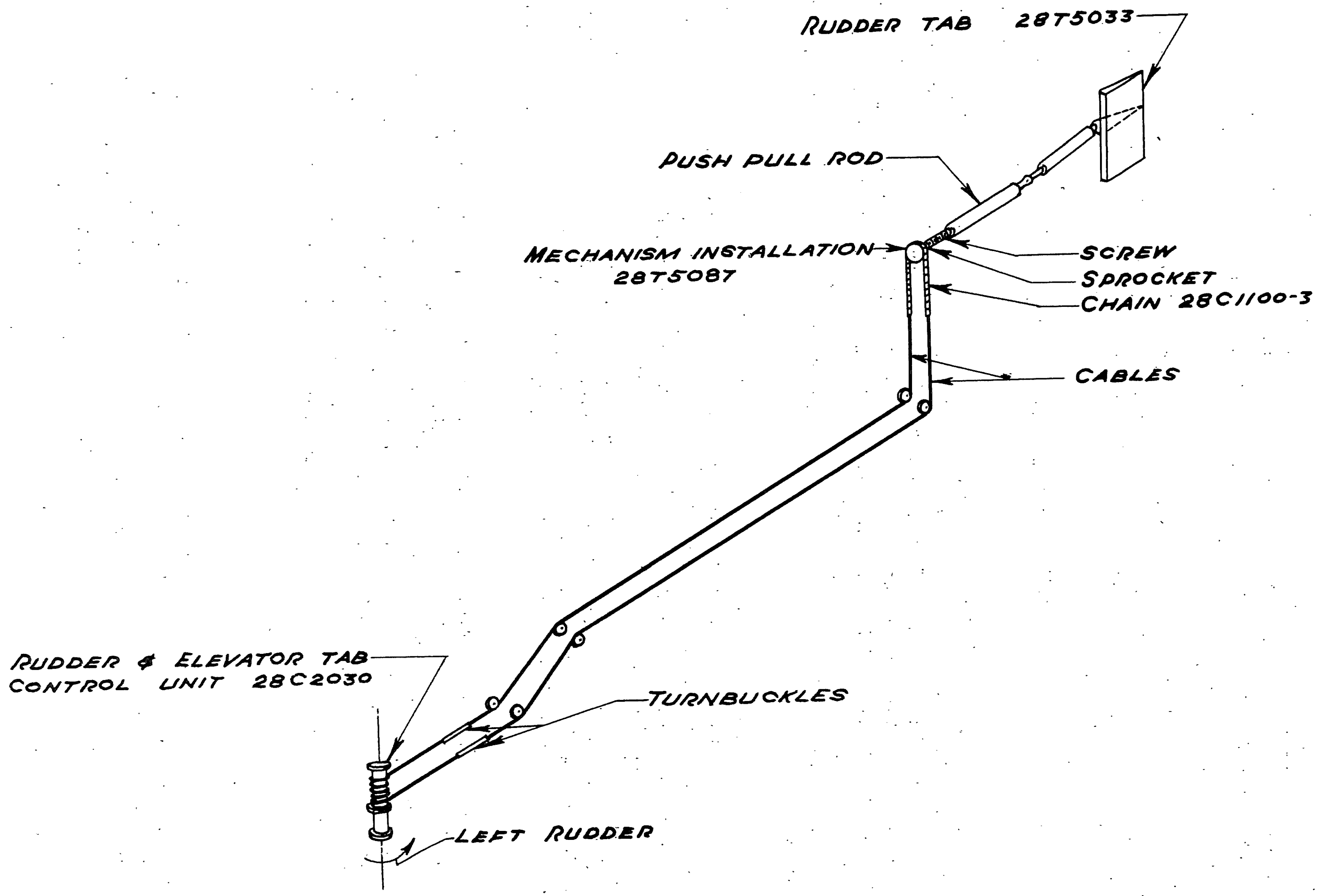
REFER TO C.A.C. DWG. 28C5700

FIGURE 73
AILERON TAB CONTROL SYSTEM



REFER TO C.A.C. DWG. 28C5700

FIGURE 74
ELEVATOR TAB CONTROL SYSTEM



REFER TO C.A.C. DWG. 28C6700

FIGURE 75
RUDDER TAB CONTROL SYSTEM

A lock is also provided for the elevator and aileron controls in the pilot's cockpit. The wheel and yoke lock holds the controls in the neutral position. To install the lock raise forward end of lock and insert aft end in socket above and behind pilot's seat. Lower forward end, moving yoke aft to neutral position. Drop pins into sockets in yoke. Strap the lock to pilot's seat supports.

To release lock, remove strap and raise forward end of lock from yoke. Move yoke forward to clear. Disengage aft end from socket on bulkhead #2. The lock is stowed just aft of bulkhead #1 on the starboard side.

### c. Tab Controls (Ref. C.A.C. Dwg. 28C5700, Figures 73, 74, 75 )

Lateral trim is secured by means of an adjustable tab on the port aileron which is operated by a control knob located in the center of the pilots' instrument panel. The knob turns a drum and operates cables that run aft, up through the superstructure and along the rear spar to a point near the aileron. The cables are attached to a chain which runs around a sprocket. The sprocket drives a screw that operates the push-pull tube connecting to the aileron tab.

Longitudinal trim is obtained by means of trailing edge tabs in each elevator. The operating mechanism is located at the ceiling of the pilot's compartment. It has cranks accessible to both the pilot and the co-pilot. The elevator tab cables wrap around a drum in the control box. A stop screw locks the cables to the drum. The control cables lead aft from the drum through the hull and lower fin to the stabilizer. There they connect to chains which loop around sprockets opposite each tab. Each sprocket drives a screw which operates the push-pull rod connected to the tab horn as in Figure

Directional trim is obtained by means of an adjustable rudder tab. The adjustment mechanism is mounted in the same housing as the elevator tab adjustment and is operated by turning the knob in the direction that trim correction is required. The operating cables run back through the hull and connect to a chain which loops over a sprocket in the fin. This sprocket drives the screw mechanism. The mechanism is connected to the tab horn by a push-pull rod.

## 2. Servicing

The control cables should be tightened after the first 10 hours of flying to take up any stretch. As far as possible, this tightening should be done with the turnbuckles which are located in the aft part of the hull. It is important to tighten both cables of any control the same amount to avoid throwing the controls out of adjustment. In addition, the adjustment should be checked after cables are tightened.

Directions for adjusting the surface controls are given in Part 4 following.

The pulleys and bearings throughout the control system are mounted on ball bearings which are packed and sealed. They should not require attention except where Zerk fittings are located, which are at rudder pedal bearings, (See Lubrication, Section VI). At engine overhaul the control cables should be loosened and each pulley turned by hand for evidence of grit or broken bearings. This is especially important when the airplane is operated from a sandy beach. Replace any faulty bearing immediately. Boots for the protection of adjustment screws are located aft of the rear stabilizer spar, at the stabilizer and elevator connection for tab controls, and at the rudder tab control connection. These boots should be removed and screws cleaned and inspected for wear or grit at each 50-hour inspection. If screws are not worn they should be greased. If they are worn and loose, they should be replaced.

Control cables are given a protective coating of Paralketone. They should be inspected every 30 hours for evidence of fraying and for looseness.

If fraying of any of the control cables has started, they should be replaced immediately. Fairleads should be replaced before they are worn to the adjacent metal.

At the 30-hour inspection, clean all chains in the control yoke and lubricate with light oil (SAE #30). The tab operating chains in the lower fin and in the stabilizer should be wiped occasionally with an oil-soaked cloth. They may be reached through holes on the upper surface of the stabilizer at the sprocket, and at the rear face of the lower fin.

3. Installation (Ref. C.A.C. Drawing 28C5700)

a. Aileron Control

To install the aileron controls, turn the control wheels on the control yoke to the neutral position. This position is found by removing the plate at the center underside of the control yoke, and turning the wheels until the turnbuckle is in the center of the opening. Clamp the wheels in this position. After the center section is rigged, connect and tighten the turnbuckles on bulkhead #5.0, holding the aileron push rod in a central position.

The stops for the aileron control are located within the ailerons themselves, at the hinge nearest the aileron mast. These stops move with the aileron and bump against the hinge bracket at the limits of travel. The stops are set at the factory to give the proper aileron movement. This movement corresponds to 267° each side of neutral on the control wheel, and 4-29/64" of movement each way on the center section aileron push rod.

When the outer panel is rigged, connect the push rod to the inboard bellcrank with a clevis bolt, which is done through a zipper opening in the top of the trailing edge portion aft of the rear spar in each outer panel. Then connect the aileron operating tube to the aileron control horn with a clevis bolt. Adjust the aileron operating tube, if necessary, to get the required droop of aileron of 1 inch. The adjustment is made through an inspection door over the outboard bellcrank, by taking out the bolt holding the operating tube to the bellcrank. Loosen the check nut on the adjustable clevis end and turn the clevis the desired amount. Ailerons are drooped 1 inch in rigging so that the nose of the aileron does not project below the lower wing contour. This should be checked in flight by observation and additional droop given if needed. The purpose of this adjustment is to prevent ice formation on the aileron nose.

After installation, check the entire system for safetying of turnbuckles and bonding of connections. Refer to C.A.C. Bonding Report 28E4027 for bonding methods.

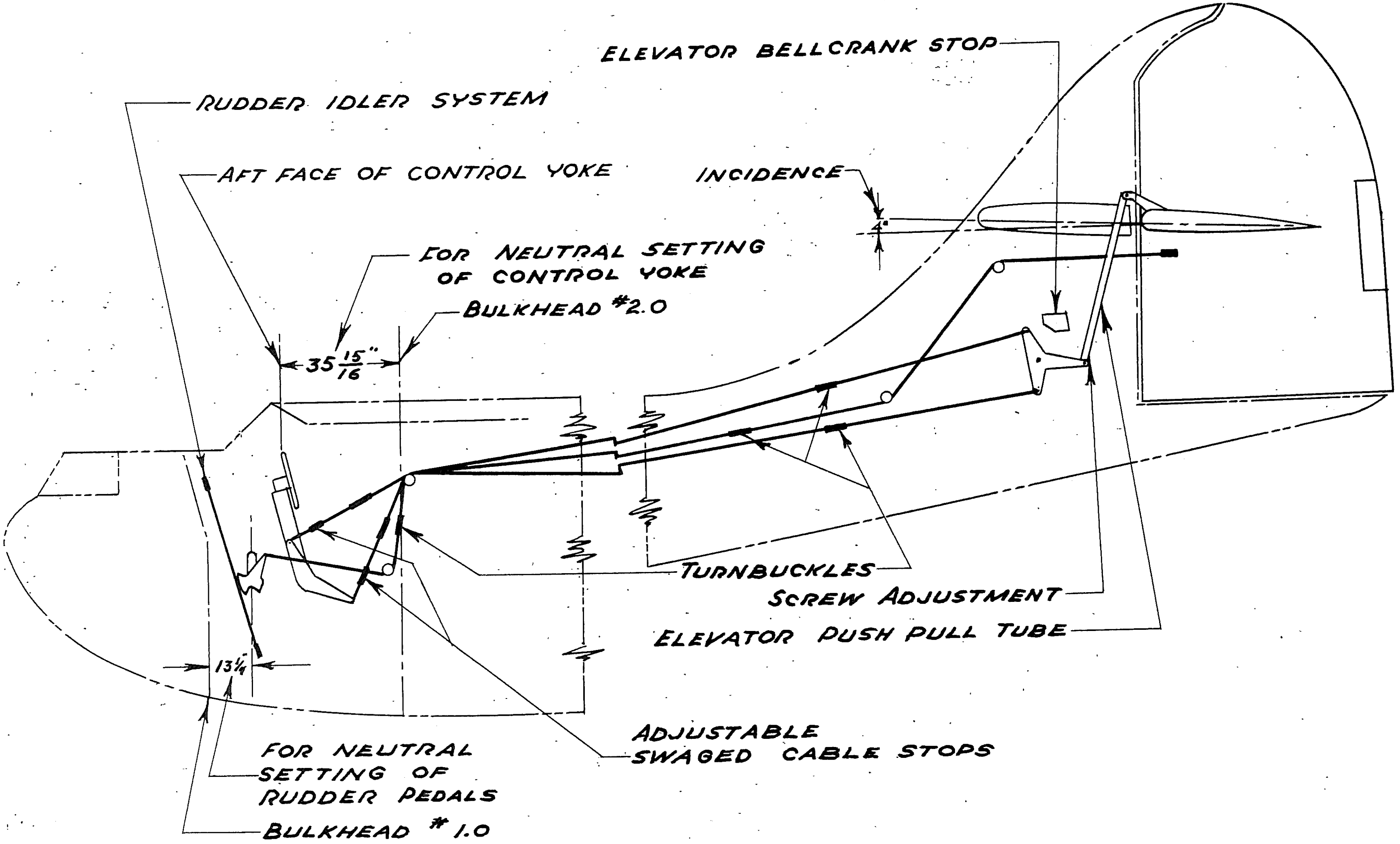
### b. Elevator Control

To install the elevator controls set the control yoke in the pilot's compartment in its neutral setting as shown in Figure 70 and fasten it in this position. Connect the elevator operating tube to the elevator control horn by a hex head bolt. Check the neutral setting of the elevator by lining it up with the stabilizer.

If adjustment is necessary, take out the bolt holding the bellcrank and operating tube together, loosen the check nut and adjust the clevis until the elevator has its required neutral setting.

There are two sets of stops on the elevator control. One set is on the cables in the pilot's compartment. The other stops are located in the lower fin and limit the travel of the elevator bellcrank. These stops are all set at the factory. However, the stops on the control cable might need adjustment when a replacement is made on the cable. Both stops are set to allow a movement of the control yoke of 7-5/16" forward and 10-11/16" aft of the neutral position. The neutral position of the control yoke is 35-15/16" from the forward face of the control wheel to the face of bulkhead #2.0. The above movements of the control yoke correspond to a 20° down movement and a 30° up movement of the elevators.

After installation, see that all turnbuckles are safety wired and all connections bonded. Refer to C.A.C. Bonding Report 28E4027 for bonding instructions.



REFER TO C.A.C. DWG.
28C5700

FIGURE 76
ELEVATOR AND RUDDER RIGGING DIAGRAM

### c. Rudder Control

To install the rudder controls, set the rudder pedals in the pilot's compartment in their neutral position as indicated in Figure 7/ and clamp the pedals in this position. Loosen the turnbuckles in the aftermost compartment. Feed the rudder cables through the fin skin and fairing slot. Attach the control cables to the rudder control horns with clevis bolts. Rig all cables to the proper tension and keep the rudder in its neutral position.

The stops for the rudder are located on the center rudder hinge bracket and bump against the rudder masts. These stops are located at the factory to give the rudder a travel of 22 degrees to each side of neutral. This corresponds to a rudder pedal travel of 4-17/32 inches each way.

After installation, see that all turnbuckles are safety wired and all connections bonded. Refer to C.A.C. Bonding Report #28E4027 for bonding instructions.

### d. Elevator Tab Control (Refer to Figure 74 .)

Before lowering the stabilizer assembly into position on the hull, remove the clevis pin guards from the pulley bracket inside the small hole at the top of the hull fin structure. Feed the elevator tab control cables from the stabilizer through this pulley bracket and replace all clevis pins. Loosen the tab control turnbuckles aft of the pilot's compartment. See Figure 74. Connect cables from the stabilizer with cables in the hull at turnbuckles in the lower part of the hull fin structure. Set the elevators and elevator tabs in the neutral position at which position the tabs have a 0° angle to the elevators (All trailing edges in line). Turn the crank on the tab adjustment mechanism in the pilot's cockpit until the pointer is at 0. Clamp in this position. Tighten the turnbuckles aft of the pilot's compartment until the correct tension in the cables prevails, then connect the socket and push tube at the stabilizer and elevator connection.

The stops aft of the pilot's compartment are set at the factory to give 5° up movement and 10° down movement of the tab with the elevator in neutral. The 10° down movement of the tab corresponds to 5.3 turns on the adjustment mechanism in the pilot's compartment.

Safety all turnbuckles and bond all connections in accordance with C.A.C. Bonding Report 28E4027.

### e. Rudder Tab Control (Refer to Figure 75 )

The rudder tab controls are attached and aligned in a manner similar to the elevator tab controls. The stops are set for a 15° movement each way or 3-1/2 turns each way on the adjustment handle in the pilot's compartment.

### f. Aileron Tab Control

The aileron tab controls are attached and aligned in a manner similar to the elevator tab control procedure given above. The stops permit the tab to move 15 degrees up or down from its neutral position.

## 4. Replacement of Parts

### a. Elevators, Rudder and Aileron (Ref. Figures 69, 70, 71)

To remove the aileron, elevator and rudder cables, loosen and disconnect the rear turnbuckles and pull the cables forward through the main bulkheads. Where cables go over pulleys and the bracket forms the guard, it will be necessary to remove the pulleys. In places where the guard is a screw and spacer, remove them, leaving the pulleys in place.

The elevator control cables are fitted with swaged stops. The tab adjustment cables are fitted with clamp type stops. When any of the cables with swaged stops need replacement, they must be replaced by whole new assemblies with the exception of the nut on the stop. The elevator stops may be changed to a new cable. A new stop assembly is not necessary. The new cable may be installed by reversing the procedure outlined above.

### b. Trim Tabs (Refer to Figures 73, 74, 75)

#### (1). Cables in Empennage

To remove the rear portion of the tab control cables, disconnect the cables at the turnbuckles in the lower part of the fin.

The elevator tab cables should be detached at the chain by reaching through the access holes on the top surface of the stabilizer. Then remove the pulleys in the stabilizer. This is done by moving the elevator to the "UP" position and moving the rudder to either port or starboard extreme position. The nut on the clevis bolt may be unscrewed through the slot in the rear fin spar. The bolt and pulleys may then be removed. The cables should be pulled free.

To install new cables the above procedure should be reversed.

#### (2). Intermediate Cables

To remove the intermediate section of the tab control cables, first disconnect the turnbuckles at the lower fin. Then pull the cables forward through the hull.

### (3). Forward Sections of Cables

To remove the forward cable sections for replacement, cut off a cable end and remove the stop. Loosen the cable at the drum in the pilot's tab control box and pull the cable out.

In order to loosen the cable on the drum, it is necessary to remove the bottom plate of the box housing and pull the tab drum out, so that set screw can be reached and unscrewed.

To install the new cable, insert its unswaged end in the cable hole of the drum. Set the drum with the cable hole aft in the beam position. Wrap the ends in accordance with the instructions on C.A.C. Drawing 28C1070. Install and connect the cable by reversing the removal procedure given above.

### (4). Tab Rod Joint

To remove the tab jointed socket at the stabilizer-elevator hinge line, it must first be disconnected from the elevator. The chain guard over the sprocket must be removed. After loosening the turnbuckle on top of the loop, the chain may be led off from the sprocket. By turning the sprocket, the socket may be unscrewed.

The rudder tab socket may be removed in a similar manner.

New sockets may be installed by reversing the above procedure.

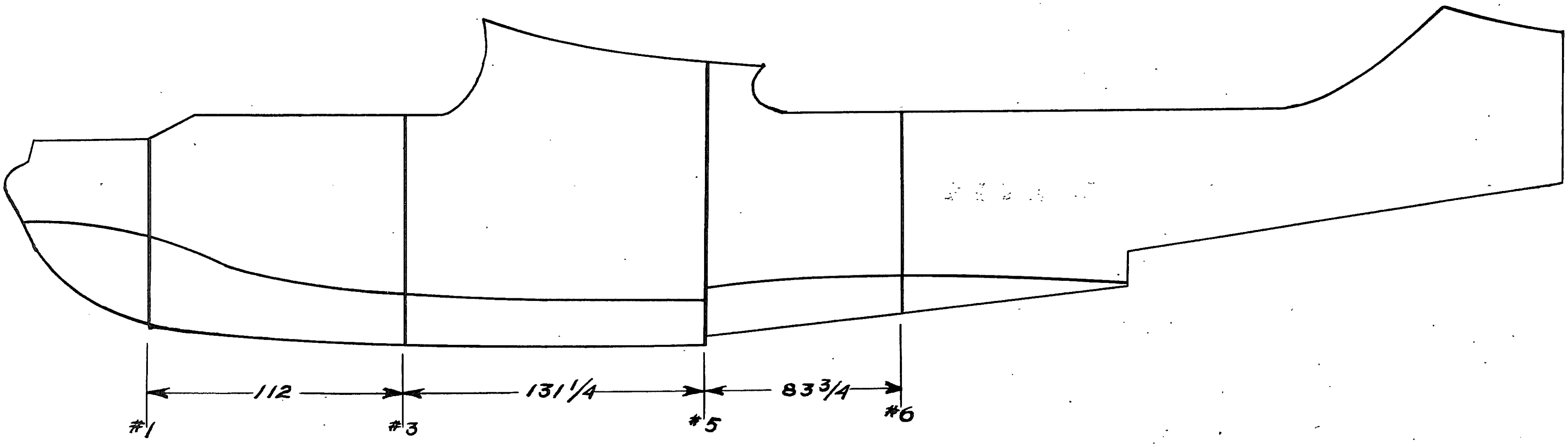
### (5). Tab Screw Mechanism

The elevator tab screw mechanism may be removed by first removing the sprocket. Then the guard aft of the stabilizer spar must be removed. After detaching the tab mechanism support on the elevator hinge bracket, the screw mechanism housing may be unscrewed. This allows the screw to be pulled aft. A few gentle taps with a lead hammer at the sprocket end of the screw will assist in removing the screw.

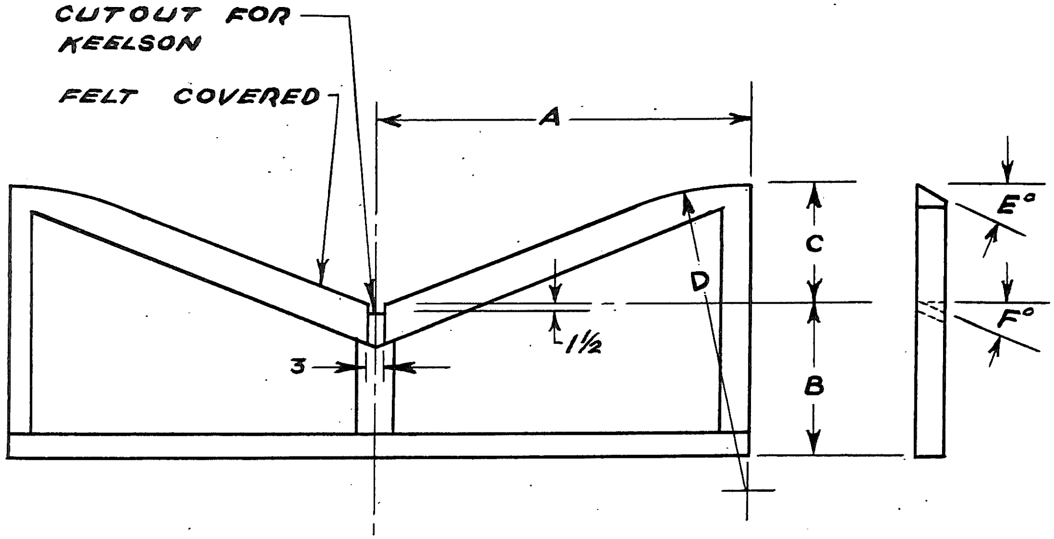
The rudder tab screw may be removed in a similar manner.

Replacement and assembly may be made by reversing the above procedure. The proper "NEUTRAL" setting is arrived at by lining up the tab with its adjacent trailing edge while the cockpit controls are kept at "NEUTRAL".

Check that all parts are safety wired and bonded in accordance with C.A.C. Bonding Report 28E4027.



LOCATION OF RIGGING CRADLE BULKHEADS



TYPICAL CRADLE BULKHEAD

TABLE OF
CRADLE BULKHEAD DIMENSIONS

| | STATION | | | |
|---|---|---|---|---|
| | 1 | 3 | 5 | 6 |
| A | 47 1/4 | 61 1/4 | 61 1/4 | 58 15/16 |
| B | 24 5/32 | 16 7/8 | 14 1/2 | 27 3/4 |
| C | 32 11/32 | 22 3/8 | 21 3/32 | 17 15/16 |
| D | 22 5/32 | 49 7/16 | 51 13/16 | 44 1/32 |
| E° | 12° | 4° | 1° | 0° |
| F° | 10 1/2° | 1° | 1° | 6° |

FIGURE 77
RIGGING CRADLE DIMENSIONS

## 5. Adjustments (Ref. C.A.C. Drawing 2805700)

Adjustments for the control surfaces are made through the aftermost turnbuckles.

Adjustments for the control column and rudder pedals are made through the turnbuckles in the pilot's compartment.

For fine adjustment of the elevator, use screw adjustment on the elevator operating tube, but make sure that there is enough thread in the socket to reach to the inspection hole.

For fine adjustment between ailerons, use the screw adjustment on the aileron operating tube, but always keep enough thread in the socket to reach to the inspection hole. Rig the ailerons to droop 1" at inboard trailing edge. Lock all turnbuckles with .040 stainless steel lockwire.

For a rigging diagram for the rudder and elevator, see Figure 76. Rigging data for all control surfaces are given in Section III, Part C.

## 6. Cable Lengths

The following cable lengths represent the complete assembly of cable with end fittings attached and should not be used in determining the actual length of cable to be cut. On threaded end fittings the total length is measured up to the end of the threaded portion. Clevis end fittings are measured to the center of the hole in the clevis. In cutting new cable from stock preparatory to making up the complete assembly with fittings, care should be taken to allow enough extra cable length for swagging end fittings.

Rudder - Portside --- Left Rudder

28C 5511-12-98 1/16" Fwd.
-15 - 3'1" Attach to Fwd. end of Servo Arm.

Servo Arm Rigged to Neutral is:
5 1/2" Aft
5 5/8" Fwd.

28C 5510-17 - 30' 5" Attach to aft end of Servo Arm
-13 - 13' 3" Aft

Rudder - Starboardside --- Right Rudder

28C 5018-19 - 8' 2 15/16" Fwd.
-16 - 36' 3 11/16" Midship
-13 - 13' 3" Aft

Aileron - Portside - Left Wing Down

28C 5512-12 - 11' 3 9/16" Fwd.
-15 - 2" 11 15/16" Attach to fwd. end of Servo Arm.
Servo Arm Rigged Neutral is Even Fwd. and Aft of Unit.
28C 5512-14 - 6' 5" Attach to Aft end of Servo Arm.
-17 - 7' 5 9/16" P.P. Tube.

Aileron - Starboardside --- Left Wing Up

28C 2086-20 - 11' 5 3/4" Fwd.
-22 - 12' 1/8" Midship - When present supply of this cable is exhausted, length will be 12' 1 1/8" as per E.O. A-21164.
-24 - 7' 5 9/16" P.P. Tube

Up Elevator - Portside

28C 5511-13 - 5' 4 1/8" Fwd.
-15 - 3' 1" Attach to fwd. end of **Servo** Arm.
Servo Arm Rigged Neutral is 6 5/16" Aft and 4 11/16" Fwd
28C 5510-16-32' 1 1/2" Attach to aft end of Servo Arm.
-12 - 6' 4 3/4" Aft.
Stop - 2' 8 1/8"

Up Elevator - Starboardside

28C 5017-31 - 5' 3 3/8" Fwd.
-25 -38' 1 7/8" Midship
-24 - 6' 4 3/4" Aft.
Stop - 2' 8 1/8"

Down Elevator - Port and Starboard

28C 5017-16 - 5' 3 3/8" Fwd.
-20 -36' 3 5/16" Midship
-23 - 8' 2 3/4" Aft
Stop - 2' 7 1/4"

Rudder Tab - Left Rudder

28C 2079-26 - 42' 1 1/4" Inboard in navigator's compartment. Fastens to starboard cable coming out of tab box off aft drum.

-20 - 52" Inboard cable in tail.

Revised 4/1/42
C.A.C.

Rudder Tab - Right Rudder

28C 2079-26 - 42' 1 1/4" Outboard in navigator's compartment fastens to portside cable coming out of tab box off aft drum.

-21 - 58" Outboard cable in tail.

Rudder Tab - Cable on Drum

28C 1123-3 - 11' 11 5/8"

Elevator Tab - Nose Up

28C 1124-27 - 40' 11 1/2" Inboard in navigator's compartment fastens to starboard cable coming out of tab box off fwd. drum.

- 2 - 94 11/16" Is outboard cable in vertical fin and attaches to elevator tab run-around in horizontal stabilizer on starboard side.

Elevator Tab - Nose Down

28C 1124-26 - 42' 3" Outboard in navigator's compartment fastens to portside cable coming out of tab box off fwd. drum.

- 3 - 90 11/16" Is inboard cable in vertical fin and attaches to elevator tab run-around in horizontal stab. on portside.

Elevator Tab Cable on Drum

28C 1123-2 - 12' 4 15/16"

Aileron Tab - Left Wing Up & Left Wing Down

28C 2082-2 - 21' 7 3/4" Two required of this length, both used along rear spar of wing. One fastening to chain over top of sprocket is Left Wing Up.

-6 - 21' 2 1/2" Two required of this length, both used in hull. One fastening to cable coming off top of drum in box is Left Wing Up.

Aileron Tab Cable on Drum

28C 2036-16 - 31' 1 13/16"

Rudder Lock

28C 4080-10 - 5' 11 5/8" Fwd.
-12 -49' 11 3/4" Aft. Two Required.

Revised 4/1/42
C.A.C.

## M. Jacking and Cradling

The airplane may be jacked up through use of a jack under each oleo strut jack pad on the main landing gear. This arrangement is principally for use in leveling or changing the landing gear wheels or tires. The hoisting sling should be used to raise the airplane any considerable distance.

To place the airplane in the cradle shown in Figure 77, assemble the cradle under the airplane. Allow the air to escape from the tires. To raise the airplane from the cradle, inflate the tires.

## N. Hoisting Sling

The hoisting sling is shown on Figure number 5 . It is attached to fittings provided on the upper surface of the wing at the airplane centerline. Attachment pins are attached to the sling by short lines to prevent their getting lost. The sling is stowed in the airplane on the front face of Bulkhead #5.0.

A method of hoisting the outer panels of the wing is shown by Figure 6.

## O. Towing, Mooring and Anchor Gear (Ref. C.A.C. Dwg. 28H1012)

### 1. Description

The towing, anchor, and mooring gear consists of the following parts:

30 lb. Northill anchor.
Anchor Reel with 150 ft. of 1/4" cable.
Mooring and Anchor Pendant, with lizard.
Clamp Assembly.
Clips and Cleat.
Towing Rings.

The anchor is stowed in a box on the port side of the hull between beltframe #0.33 and bulkhead #1.0. The reel is stowed in the anchor box as shown in Figure number 129.

Care must be exercised when breaking out the anchor to avoid too violent action in breaking out with a resulting twisting of the anchor shank or fluke arm.

If the anchor clamp assembly begins to lose its holding power it will probably be due to the brass liner in the clamp becoming worn. C.A.C. Drawings 28H1035, 28H1036, and 28H1037 show the method of installing a new liner.

## 2. To Drop Anchor

a. Obtain crank from engineer's compartment.
b. See that reel is locked.
c. While standing on mooring platform, remove anchor from its box. Unfold anchor and drop it over the side, threading cable through run provided on mooring platform.
d. Unlock reel.
e. By using brake, allow cable to feed out slowly to length desired.
f. Attach clamp on mooring pendant to anchor cable.
g. Use brake to permit cable to feed out until entire anchor load is taken by mooring pendant. Sufficient slack should be left to insure that no tension will be put on the reel lock mechanism.
h. Lock reel.

## 3. To Weigh Anchor

a. Break anchor loose by use of engines. Care must be taken that the anchor load is taken by the pendant and not by the reel. Handle airplane to break anchor out easily and smoothly.
b. Unlock reel.
c. Wind cable in by means of hand crank, until mooring pendant clamp is accessible from mooring platform.
d. Lock reel.
e. Release cable clamp.
f. Unlock reel.
g. Crank cable in until anchor hangs just below surface of water.
h. Lock reel.
i. Hoist anchor with buoy hook to within reach of mooring platform.
j. Hoist anchor aboard, taking care that it does not come into contact with hull below mooring platform.
k. Fold and stow anchor in its box.
l. Stow mooring pendant in its proper place in anchor box.
m. Stow lizard in anchor box.
n. Close anchor box door.
o. Lock reel.

The mooring pendant is attached to the keel at bulkhead #1.0. It is drawn around a clip on the port side of the hull and stowed inside the anchor box. The lizard is stowed inside the anchor box on top of the pendant.

A mooring platform is attached to each side of the bow. Eyes are provided on the side of the hull above each platform for attachment of a gunner's safety belt to be used when mooring the airplane. See figure 21 .

4. Towing Ring

Wing handling line fittings in the leading edge of each outer panel are shown on Figure 13. Press on the bottom of the ring to open.

The mooring pendant at the bow may be used for towing.

P. Beaching Gear (Ref. Figures 78 & 79)

The PBY beaching gear may be attached to this airplane. The two side fittings are located below the wing brace strut fitting. The tail gear fittings are located on the bottom of the hull, aft of the tunnel gun hatch.

Q. Parking

To set the brakes for parking, apply pressure to the brake pedals, located at the tips of the rudder pedals. Then turn the parking knob to the locked position. This knob is located below the pilot's instrument panel on the panel cross brace. Release toe pedals.

The control surfaces should also be locked from the cockpit. Tie down lines should be run to the wing handling fittings and the rear hull towing fittings, in order to securely moor the airplane.

R. Pilots' Equipment

1. Pilots' Seats (Ref. C.A.C. Dwg. 28F1024)

The pilots' seats are adjustable and tiltable on an incline three inches fore and aft of the neutral position. To release seat for adjustment, pull up on the handle located on the outboard side of the seat. The seat is moved aft by the weight of the pilot and returns forward by means of elastic shock cord under tension. To tilt seat, push lever on front of the seat to the left and tilt seat to desired angle.

2. Safety Belt

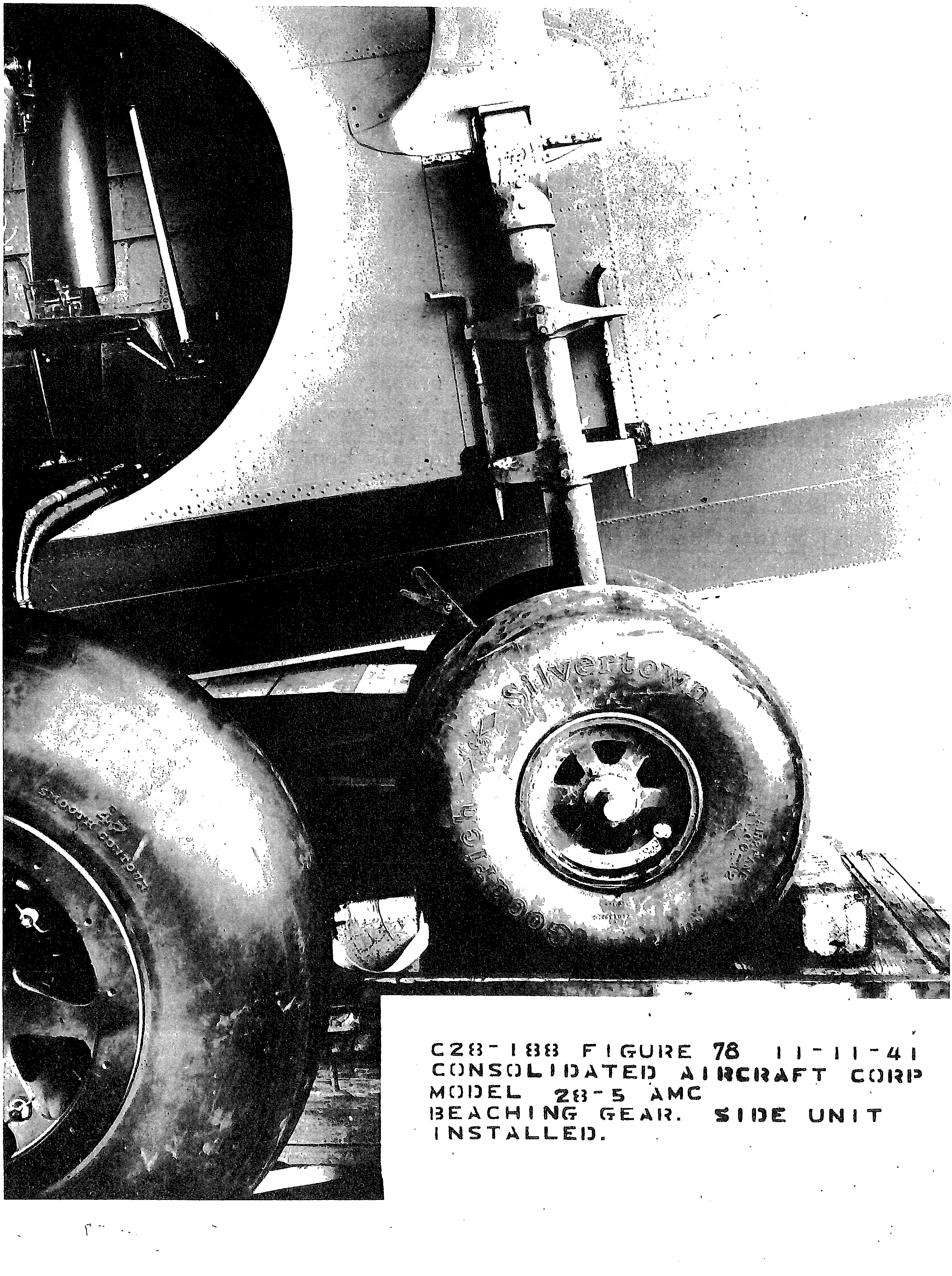
The pilots' safety belts (Type NAF 39941) are attached to each seat.

3. Miscellaneous

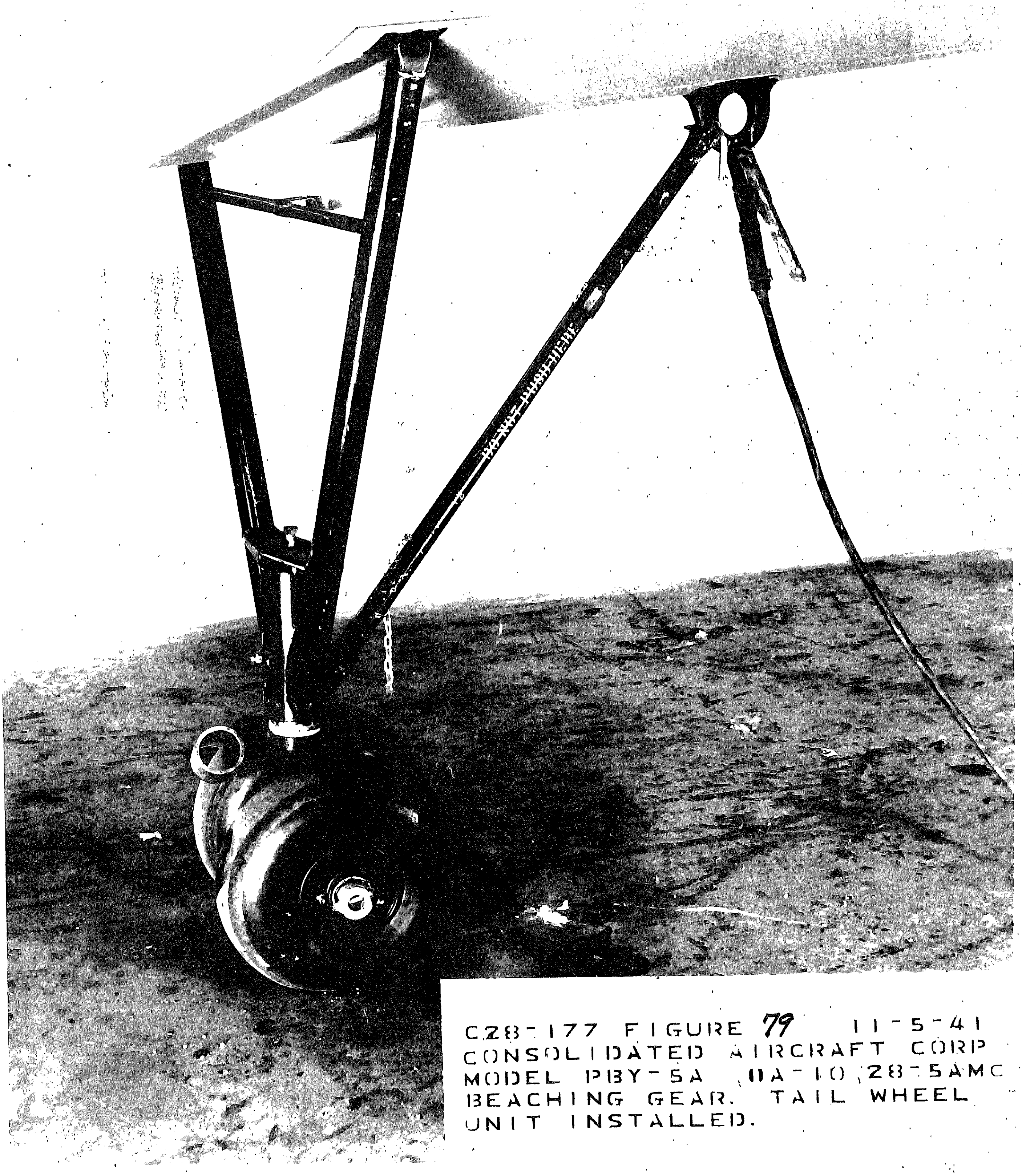
The miscellaneous equipment such as maps, spot light, etc., are covered under "Miscellaneous Equipment" in Section V of this handbook.

S. Living Compartment (Figures 83 & 84)

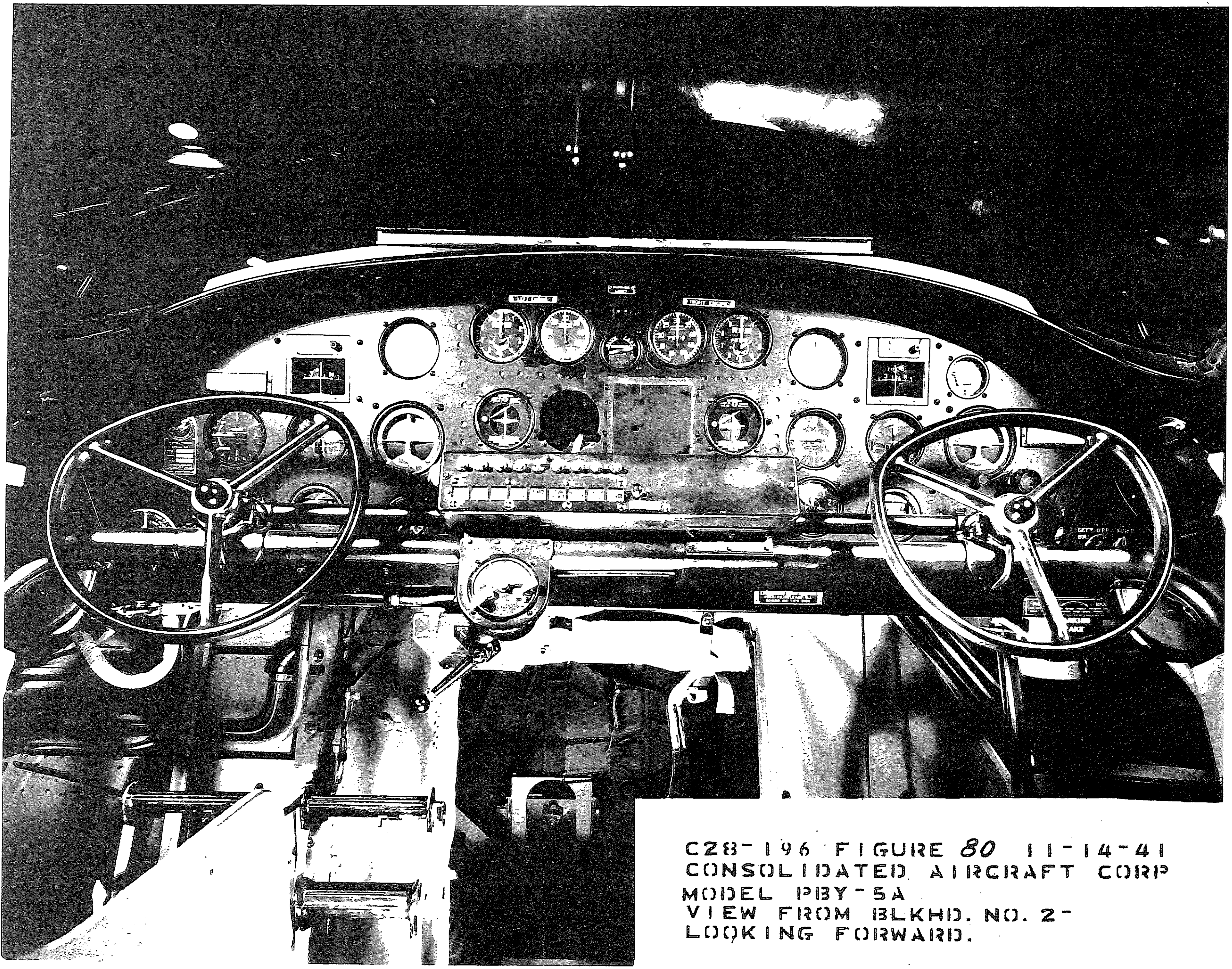
The living compartment is that portion of the airplane located between bulkheads #5.0 and #6.0. It is equipped with four bunks for members of the crew. There is a safety belt attached to each bunk.



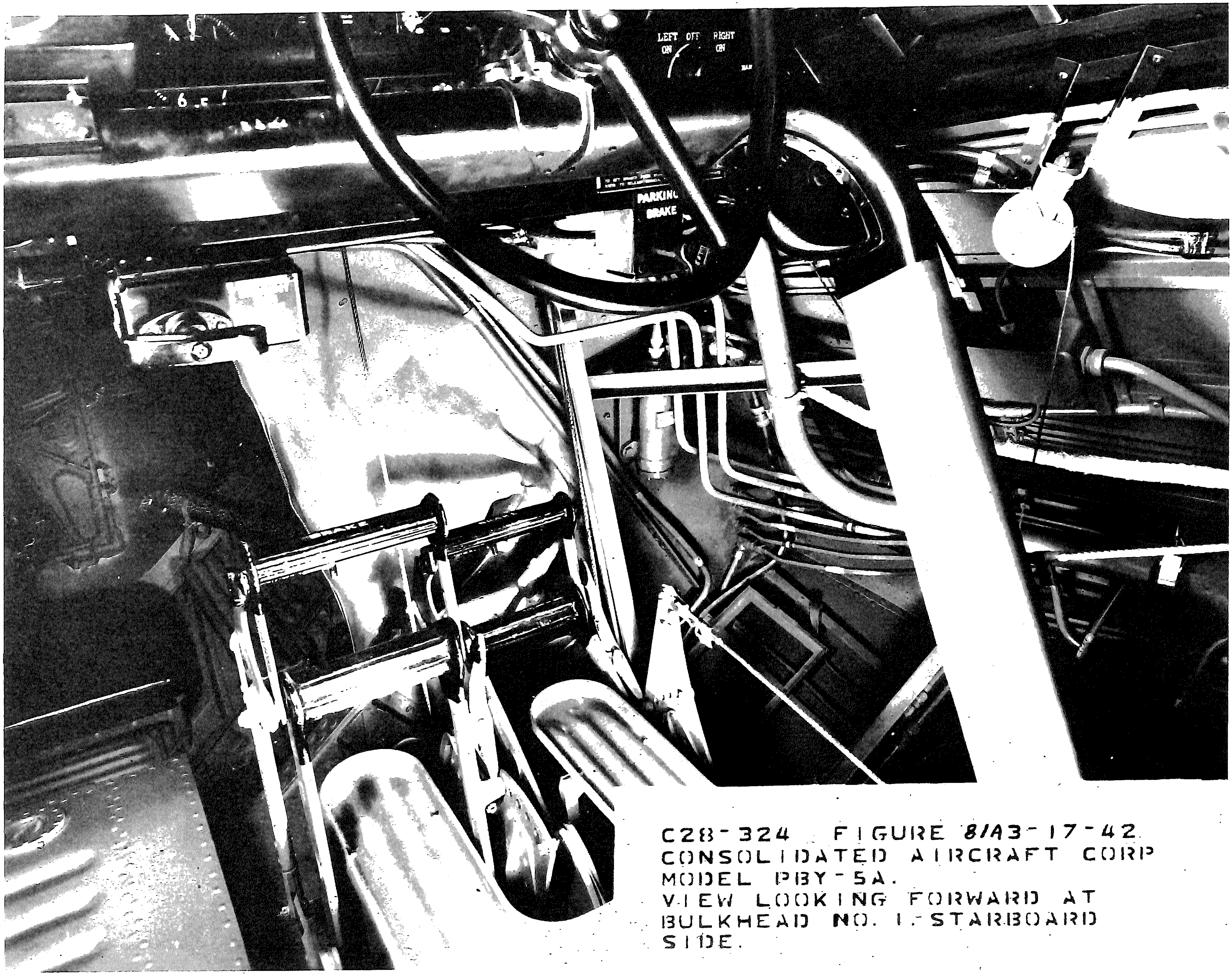
C28-188 FIGURE 78 11-11-41
CONSOLIDATED AIRCRAFT CORP
MODEL 28-5 AMC
BEACHING GEAR. SIDE UNIT
INSTALLED.



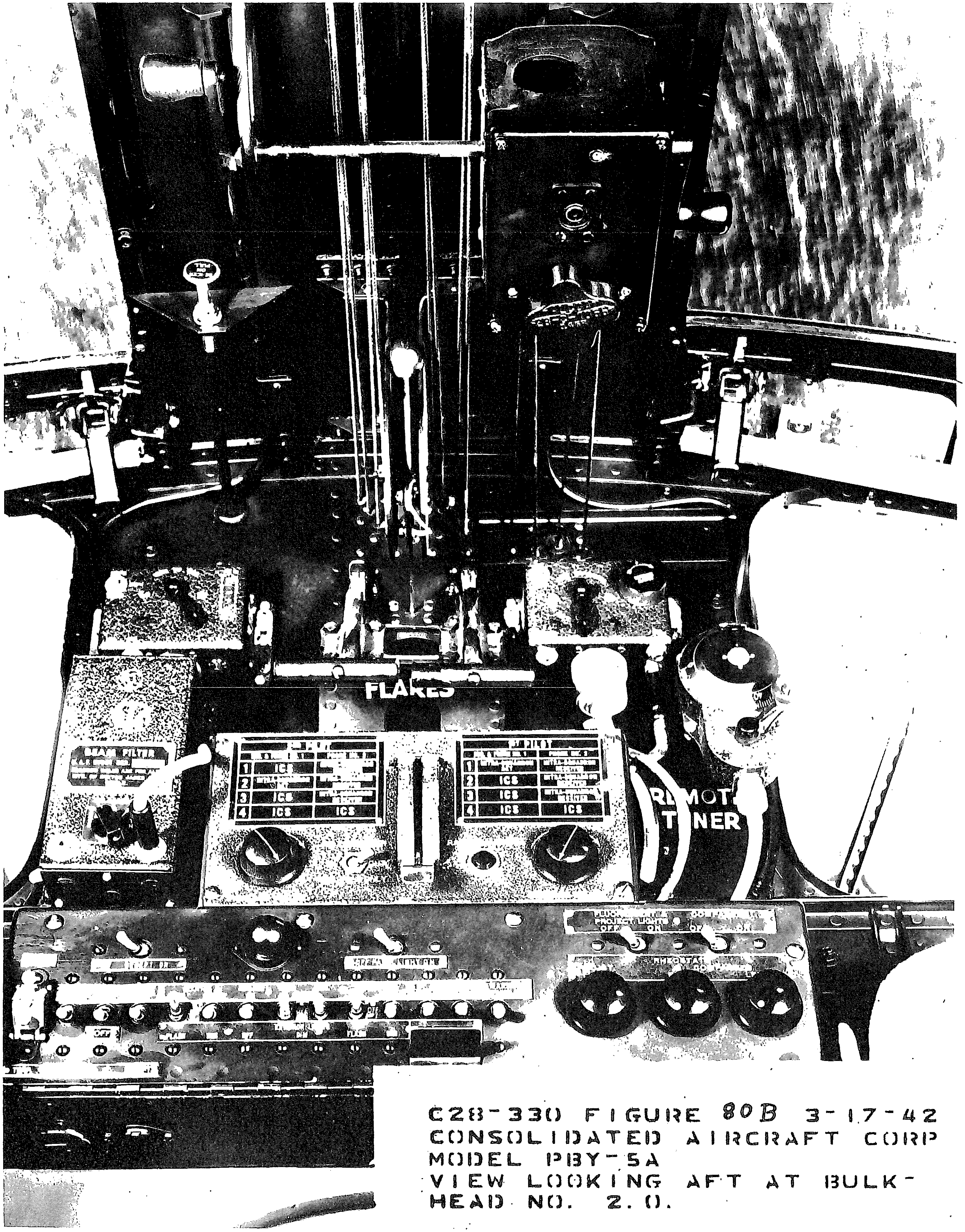
C28-177 FIGURE 79 11-5-41
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A (OA-10) 28-5AMC
BEACHING GEAR. TAIL WHEEL
UNIT INSTALLED.



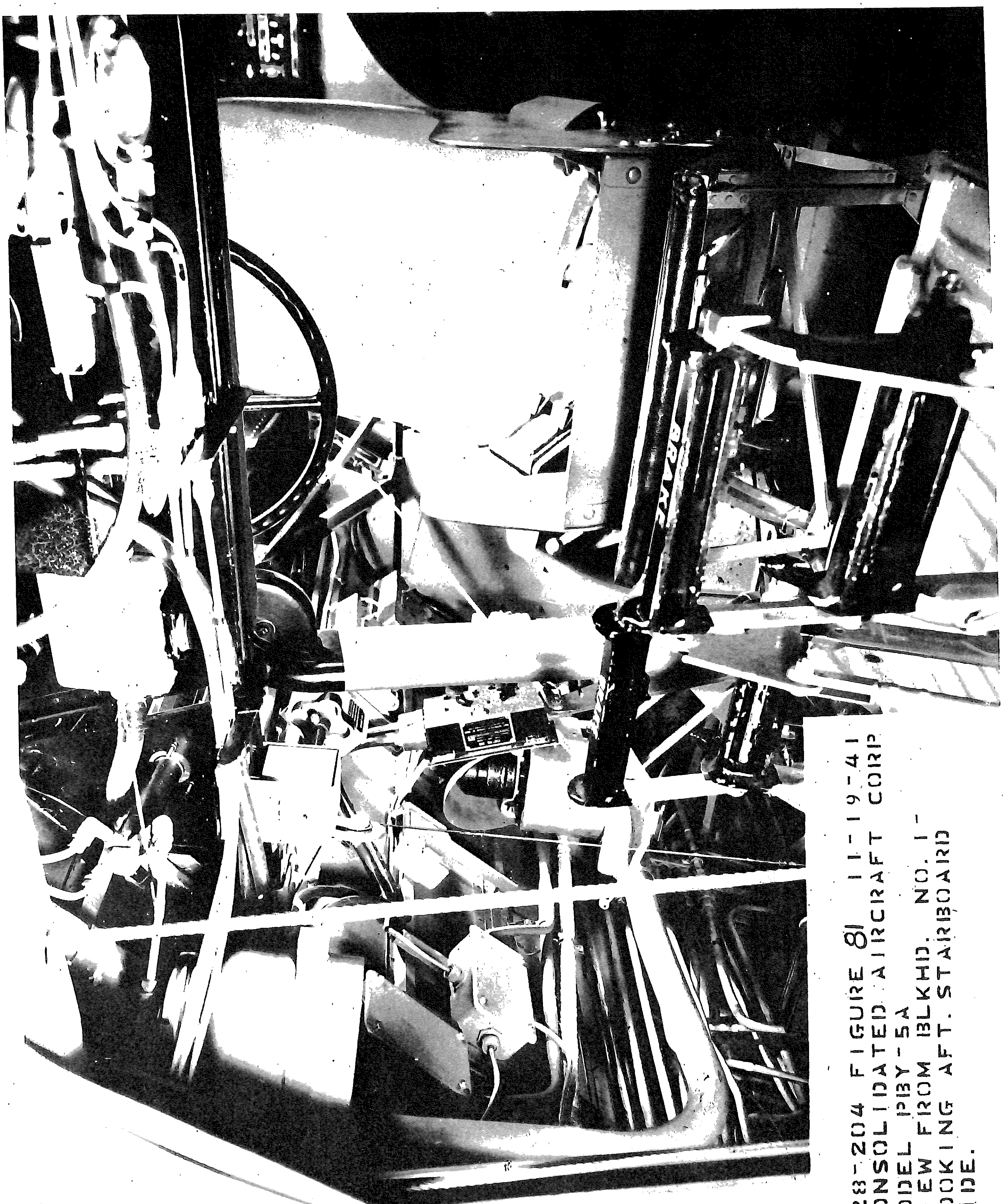
C28-196 FIGURE 80 11-14-41
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A
VIEW FROM BLKHD. NO. 2-
LOOKING FORWARD.



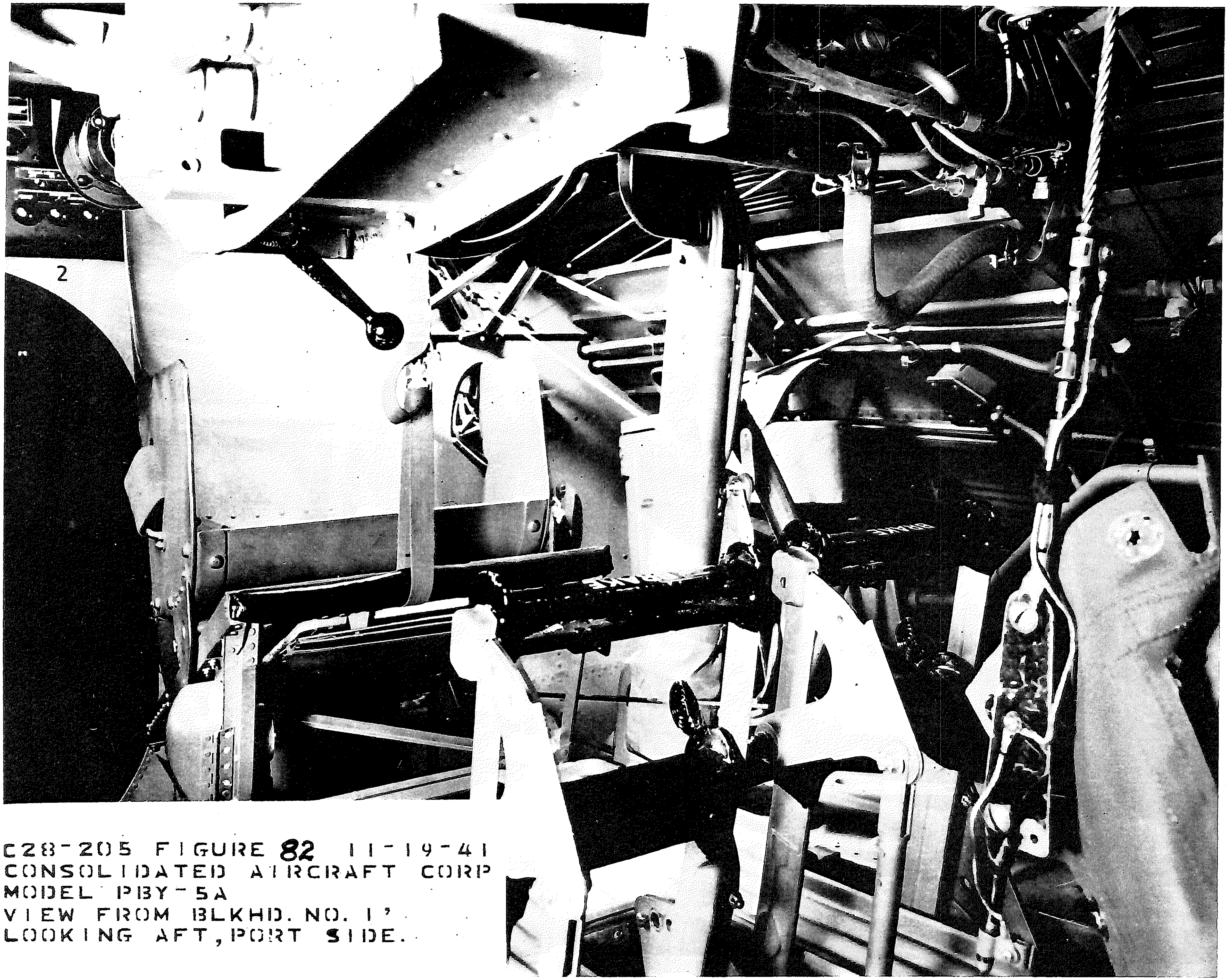
C28-324 FIGURE 8/A3-17-42
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A.
VIEW LOOKING FORWARD AT
BULKHEAD NO. 1-STARBOARD
SIDE.



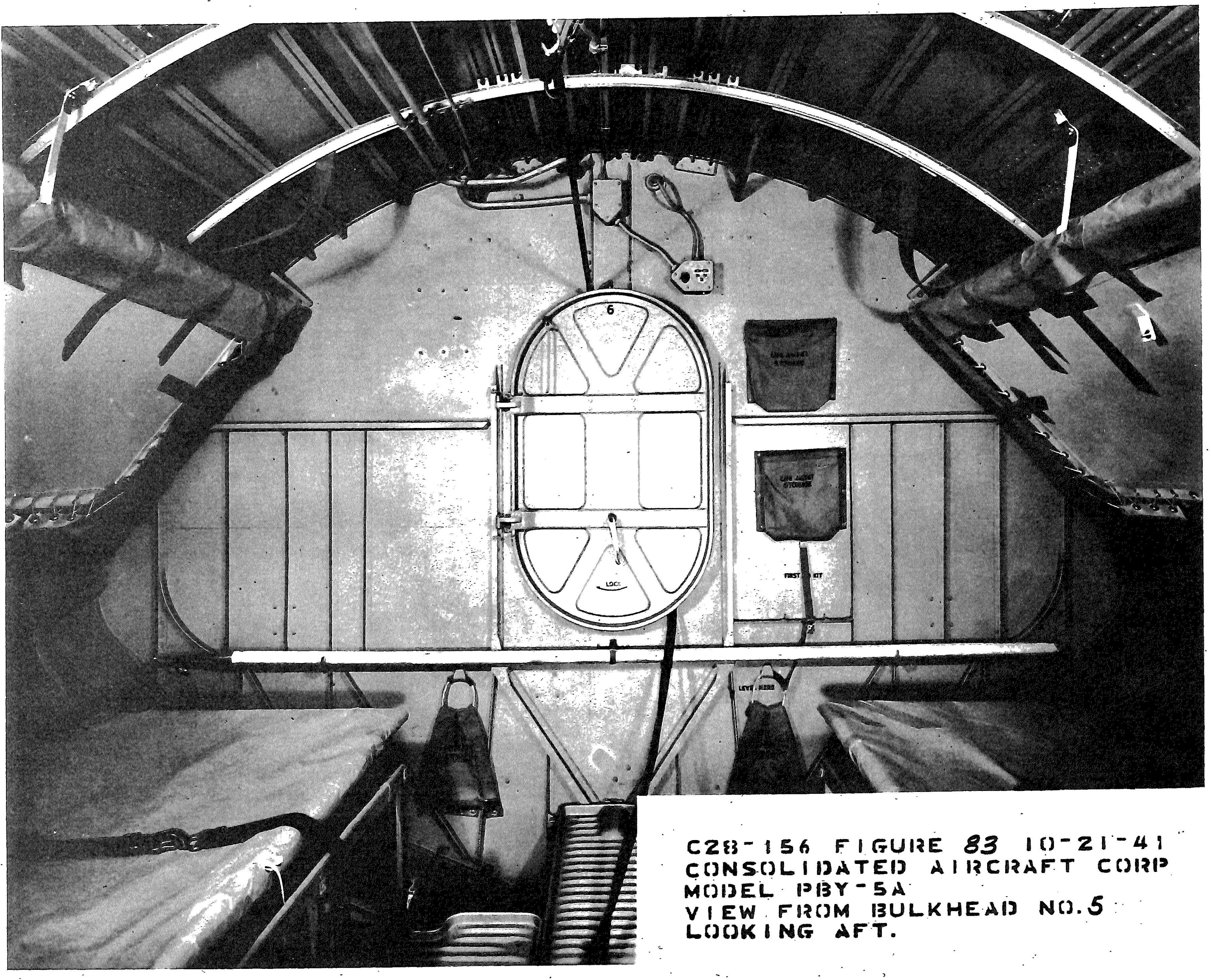
C28-330 FIGURE 80B 3-17-42
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A
VIEW LOOKING AFT AT BULKHEAD NO. 2.0.



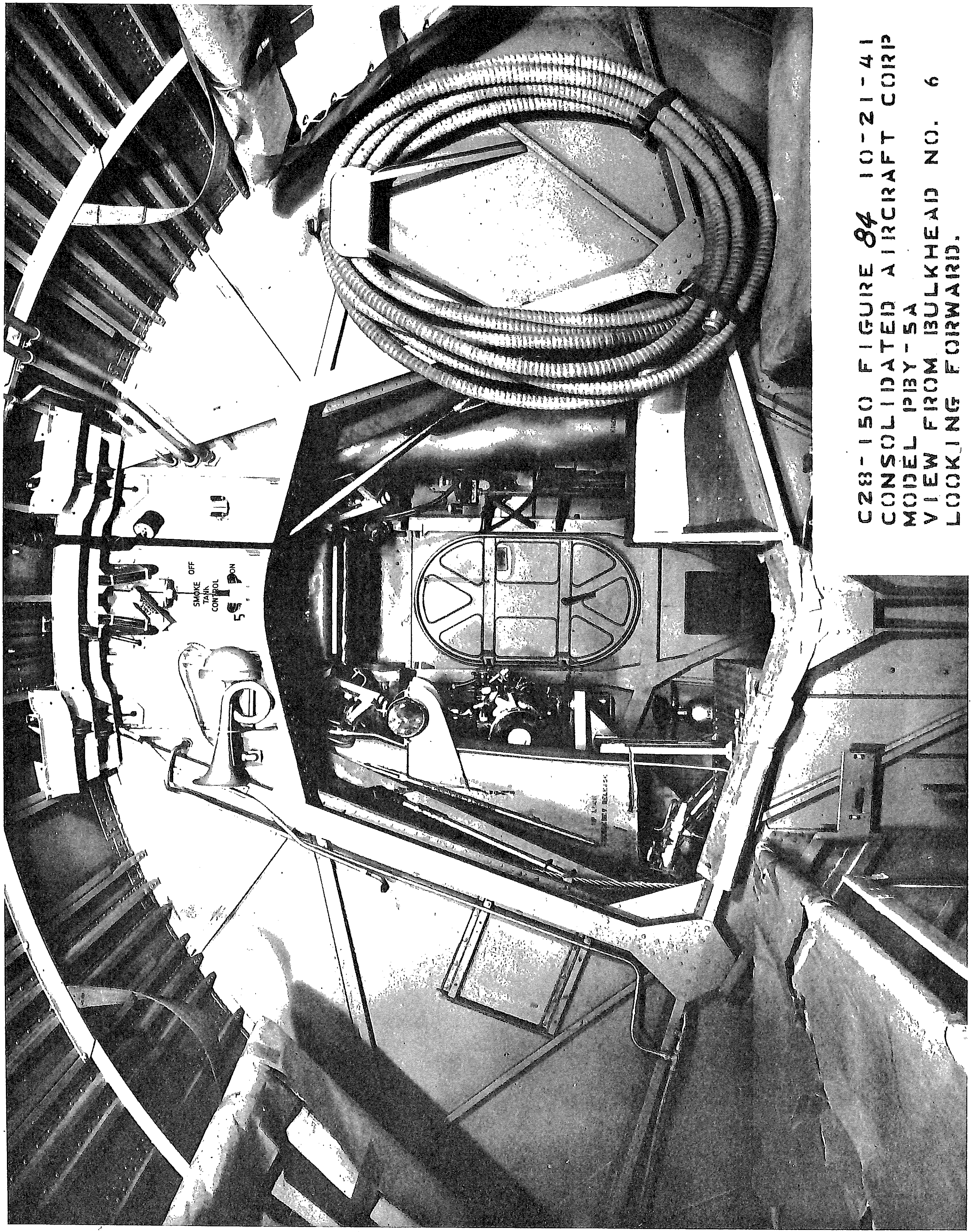
C28-204 FIGURE 81 11-19-41
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A
VIEW FROM BLKHD. NO. 1-
LOOKING AFT. STARBOARD
SIDE.



C28-205 FIGURE 82 11-19-41
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A
VIEW FROM BLKHD. NO. 1’
LOOKING AFT, PORT SIDE.



C28-156 FIGURE 83 10-21-41
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A
VIEW FROM BULKHEAD NO.5
LOOKING AFT.



C28-150 FIGURE 84 10-21-41
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A
VIEW FROM BULKHEAD NO. 6
LOOKING FORWARD.

A locker for miscellaneous gear and tools is provided in the living compartment between stations #4.5 and #5 on the port side of the airplane. The locker is divided into two parts: The forward section is for miscellaneous gear, and the aft for tools. The miscellaneous gear locker provides stowage for two hand flashlights and spare batteries, one canvas bucket, one hundred feet of coiled rope (one inch circumference), and spare parts for the engine and airplane. An engine tool kit, special tool kit, and complete tool kit are stowed in the tool locker.

## T. Navigator's Compartment (Figures 85 + 86)

The navigator's compartment is located between bulkheads #2 and #4 on the port side of the airplane. This compartment contains the navigator's table, a watch drawer, drawer for maps, an adjustable chair with safety belt attached, a bookcase, and a locker for stowing miscellaneous items. For complete navigator's equipment, refer to Section V.

## U. Food and Water Supply

### 1. Food Lockers (Ref. C.A.C. Dwg. 28F4122)

Two food lockers furnish stowage for 140 pounds of food.

### 2. Water Tanks (Ref. C.A.C. Dwgs. 28F4020, 28F5916)

The airplane carries four 4 1/2 gallon water tanks. Two tanks are located on the aft port face of bulkhead #2. They are strapped to a bracket by means of two straps stenciled "Water Tanks" The other two tanks are located between stations #4 and #4.1 on the starboard side of the airplane.

### 3. Water Distilling Unit

A water distilling unit, for emergency water supply may be installed in the mid-section of the airplane.

## V. Ventilating System

Ventilation is secured through openings in the sides of the hull. These ventilators, shown on Figure 21, may be manually operated from inside the airplane.

## W. Heating System (Ref. C.A.C. Dwg. 28F6169)

### 1. General Description

The heating system is a fuel-air mixture type system. It consists of the following: a gasoline engine-driven blower, carburetor, defrosters and individual heaters at each crew station. One heater is installed at the starboard waist gun position to serve both stations. Fuel-air mixture is produced by the blower which, by drawing the mixture through a carburetor, will furnish it under pressure for operation of the heaters and gasoline engine. Two defrosters are provided, one for the bomber's window and one for the pilot's windshield.

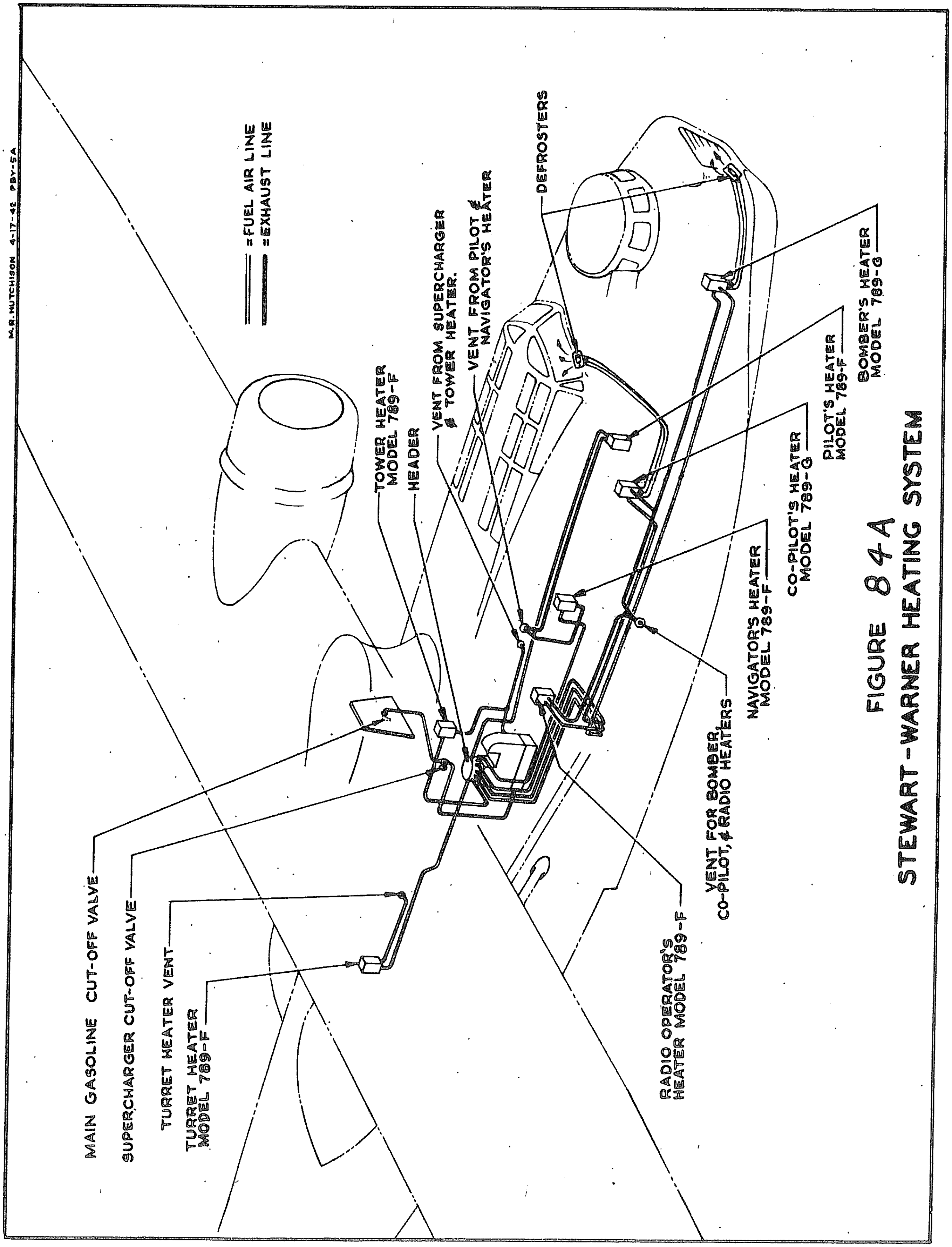

M.R. HUTCHISON 4-17-42 PBY-5A
= FUEL AIR LINE
= EXHAUST LINE
DEFROSTERS
VENT FROM PILOT & NAVIGATOR'S HEATER
VENT FROM SUPERCHARGER & TOWER HEATER.
TOWER HEATER MODEL 789-F
HEADER
BOMBER'S HEATER MODEL 789-G
PILOT'S HEATER MODEL 789-F
CO-PILOT'S HEATER MODEL 789-G
NAVIGATOR'S HEATER MODEL 789-F
VENT FOR BOMBER, CO-PILOT, & RADIO HEATERS
RADIO OPERATOR'S HEATER MODEL 789-F
MAIN GASOLINE CUT-OFF VALVE
SUPERCHARGER CUT-OFF VALVE
TURRET HEATER VENT
TURRET HEATER MODEL 789-F

FIGURE 84A
STEWART-WARNER HEATING SYSTEM

Revised 4/1/42
C.A.C.

## 2. Operation

### a. Starting on Ground or Water

To start this system on ground or water without having main engines running, use auxiliary power plant unit, (starting load approximately 43 amperes with 4 units).

(1) Turn auxiliary (NEP) fuel selector valve at mechanic's panel to "ON".

(2) Open plug valve in heating engine fuel line, (just above NEP constant level float chamber).

(3) Start the auxiliary power unit.

(4) On main electric distribution box (R.H. forward side of bulkhead #4) set:

  (a) Auxiliary Generator switch on Bus "A".

  (b) Heater switch on Bus "A" (Both switches may be on Bus "B").

(5) Set switch on relay box (bulkhead #4 below main distribution panel) to 4 units position.

(6) Open throttle valve on mixture blower unit. (Blower is installed on R.H. forward side of bulkhead #5).

(7) Start mixture blower engine (starting rope provided). Wrap around pulley at inboard end of engine so rope pulls from under side of pulley. Push choke button as required during start.

(8) Adjust throttle valve so that mixture pressure gage registers 2 lbs. per sq. in.

(9) After three minutes, snap heater switch on relay box to 8 units position.

(10) After three additional minutes bring main and auxiliary battery switches on main distribution panel to Bus "A".

(11) Stop auxiliary power unit.

(12) Operate heaters from batteries. (Approximately 10 amperes are being used.) (For overnight operation of heaters it will be necessary to recharge the batteries by running the auxiliary power unit at regular intervals.)

Revised 10/5/41 (C.A.C.)

b. Starting in Flight

(1) On electric main distribution panel (R.H. forward side of bulkhead #4) set:

(a) Auxiliary generator switch on Bus "A".

(b) Starboard generator switch on Bus "A".

(c) Main battery switch on Bus "A".

(d) Heater switch on Bus "A" (All switches may be on Bus "B")

(2) Set switch on relay box (bulkhead #4 below main distribution panel) to 4 units position.

(3) Turn auxiliary (NEP) fuel selector valve at mechanic's panel to "ON".

(4) Open plug valve in heater engine fule line (just above NEP constant level float chamber).

(5) Open throttle valve on mixture blower unit.

(6) Start mixture blower unit.

(7) Adjust throttle valve to 2 lbs. per sq. in. if below 12,000 ft. altitude. (Above 12,000 ft. turn throttle full on).

(8) After 3 minutes snap heater switch on relay box to 8 units position.

(9) After approximately three additional minutes, the operating current will drop to 10 amperes.

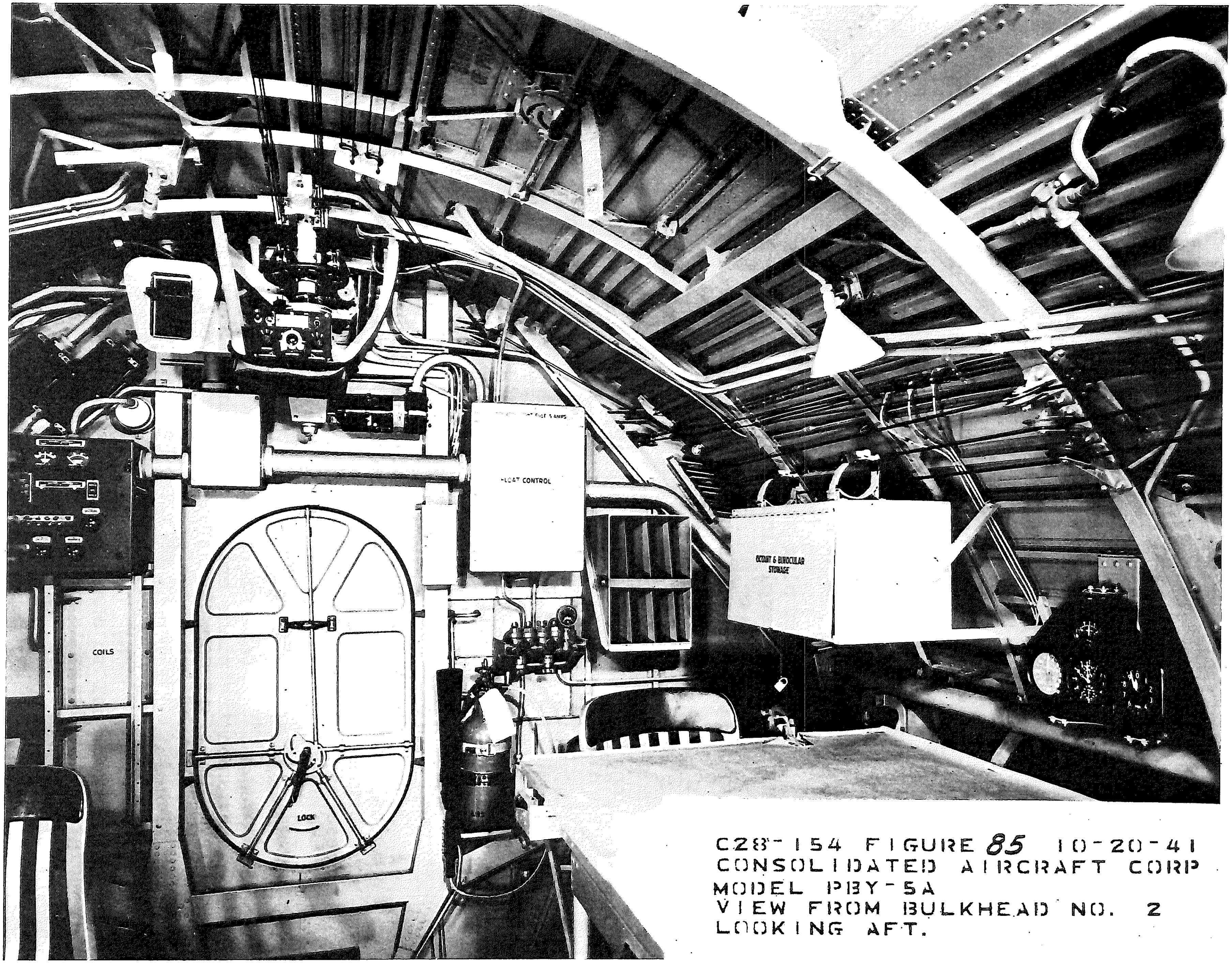
c. Service and Maintenance

Check the fuel and electrical supply if heater fails to operate. After 20 hours of operation the heater casting and oven assembly should be inspected for carbon and lead deposits and, if necessary, these parts should be thoroughly cleaned.

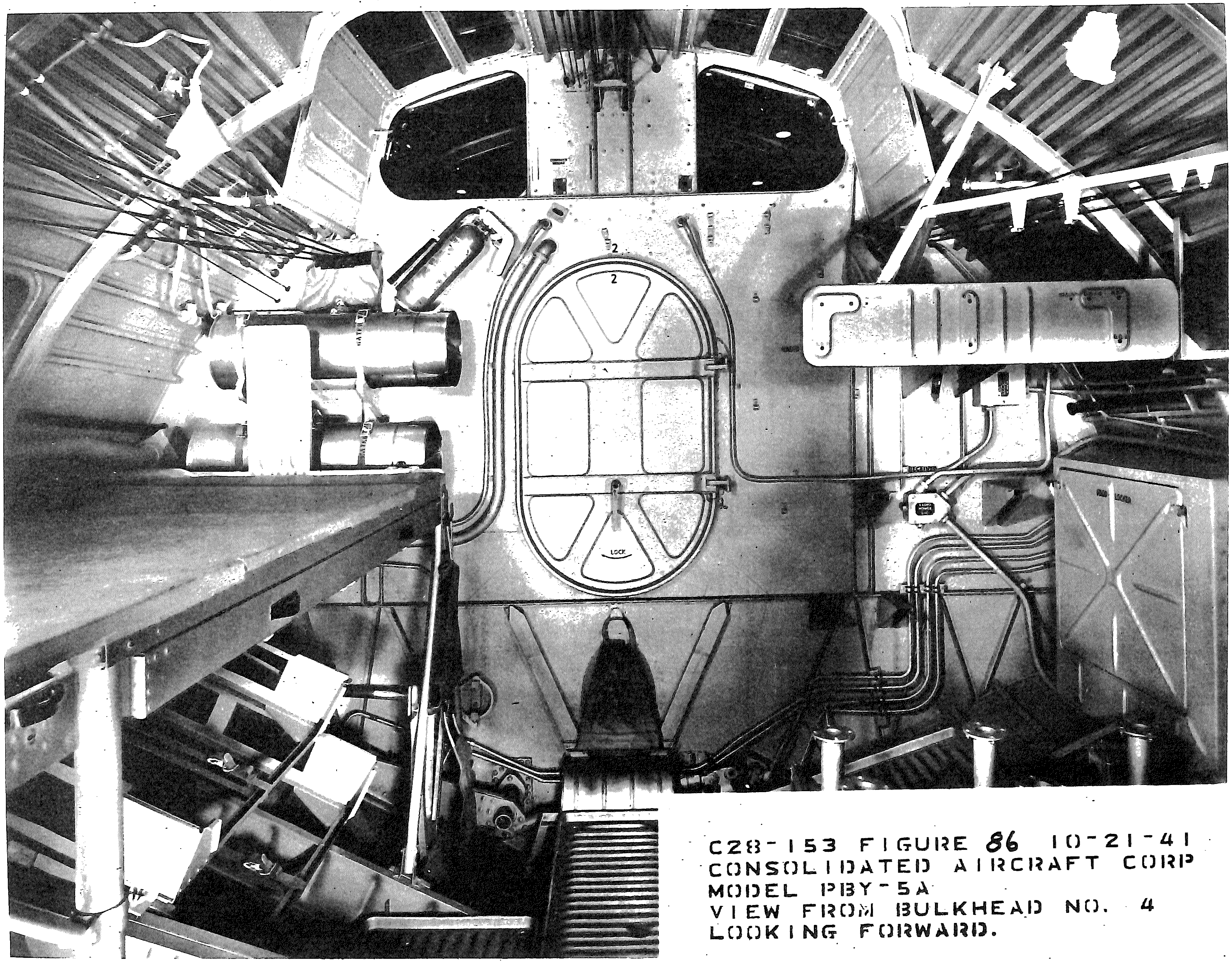
(1) Heater Fails to Ignite

(a) Check fuel supply. As the fuel supply is dependent upon the plane engine super-charger or Model 782 Super-Charger Unit, it can be assumed that the fuel system is in order if the engine operates satisfactorily, lines are clear and connections are tight.

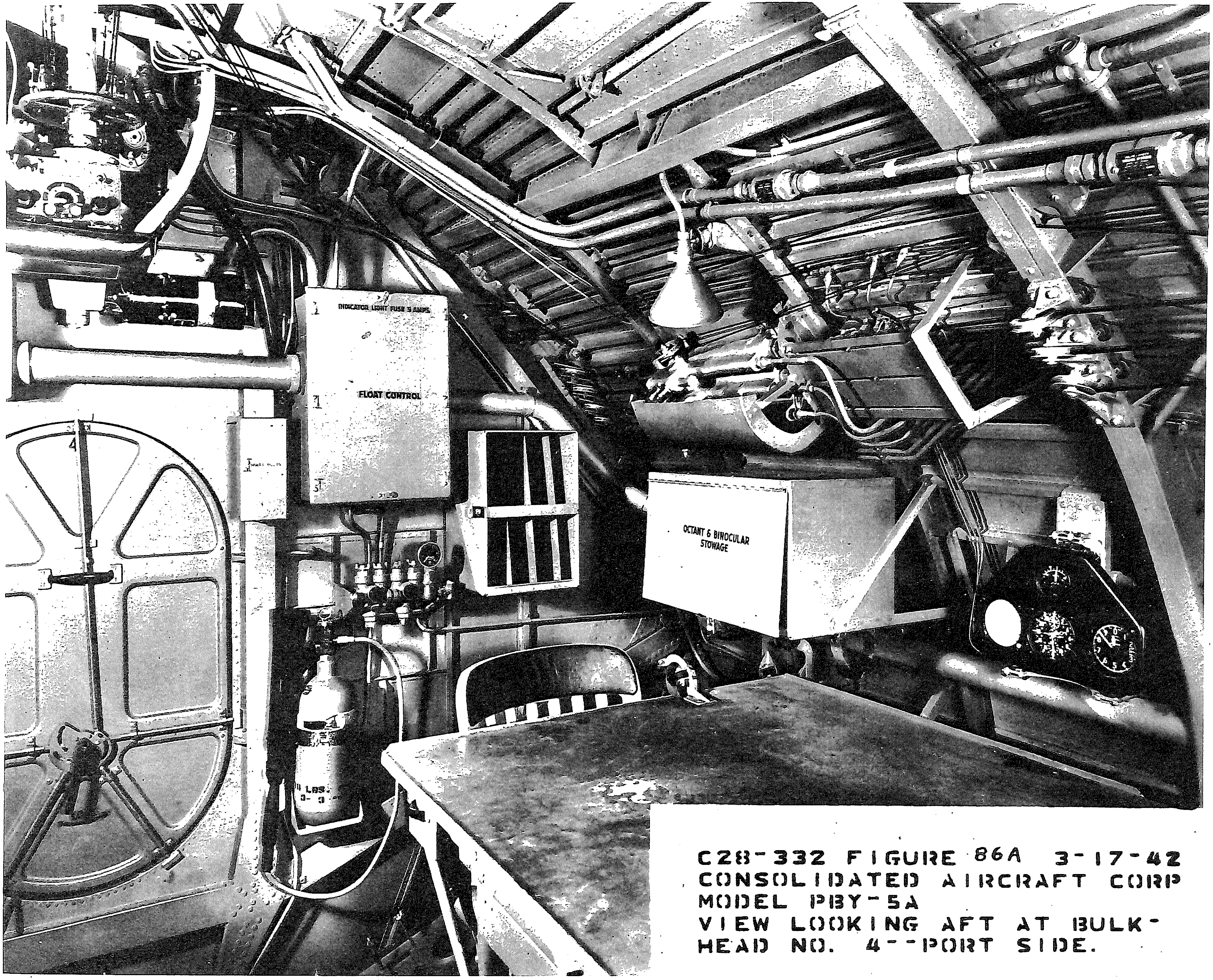
(b) Check igniter. First connect voltmeter to the igniter terminal to check voltage from source of supply to this point. If voltage is present it should be not less than 11V on a 12V system, or less than 23V on a 24V system. The outer casting



C28-154 FIGURE 85 10-20-41
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A
VIEW FROM BULKHEAD NO. 2
LOOKING AFT.



C28-153 FIGURE 86 10-21-41
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A
VIEW FROM BULKHEAD NO. 4
LOOKING FORWARD.



C28-332 FIGURE 86A 3-17-42
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A
VIEW LOOKING AFT AT BULKHEAD NO. 4--PORT SIDE.

should become warm. If unit remains cold, the coil is burned out and the igniter must be replaced. When the voltmeter fails to show a voltage at the igniter terminal the switch adjustment must be checked.

(2) Fan Motor Fails to Operate

(a) First check voltage to fan motor by using fan motor terminal.

(b) If motor does not operate when voltage is present at terminal, the motor must be replaced.

d. Overhaul

(1) Remove igniter and back casting assembly.
(2) Clean igniter by blowing into its interior with compressed air.
(3) Remove baffle cup from back casting by first prying its sides in with a punch and then pulling it out with long nose pliers. It must be replaced with a new cup.
(4) Clean burner tube. With baffle cup still removed the burner tube may be cleaned with a #13 drill. CAUTION: Do not disturb position of burner tube as its angle setting is a factory operation and cannot be adjusted in the field.
(5) Before inserting new baffle cup clean the sides of the ignition chamber with emery paper. Now new cup will slide easily into place. When in position the small lug of the cup should be bent into the igniter chamber to hold the cup in position.
(6) Clean oven assembly using a long narrow wire brush. Each passageway should be cleaned, then blow out all the dirt, using compressed air.
(7) If reigniter (fireclay) is broken it must be replaced.
(8) Replace reigniter, casting and igniter gaskets, and reassemble heater.
(9) Check switch for proper adjustment. Excessive arcing at switch contact points indicates a faulty condenser. To eliminate such a condition old condenser must be replaced.

## X. Miscellaneous Equipment

### 1. Bilge Pump

A bilge pump is installed adjacent to the auxiliary power plant. Complete operating instructions are furnished with the bilge pump. Sufficient hose is provided for the pump to reach all water-tight compartments. It is stowed on the aft face of bulkhead #5.

### 2. Entrance Ladders (Ref. C.A.C. Dwg. 28F4080)

A removable ladder is provided for entrance into the ship from either side through the rear gun blisters. It conforms to the contour of the hull and is supported at the top and center by hooks on the ladder which engage eyebolts on the side of the hull. A spring catch located at one of the upper hooks prevents the hooks from disengaging.

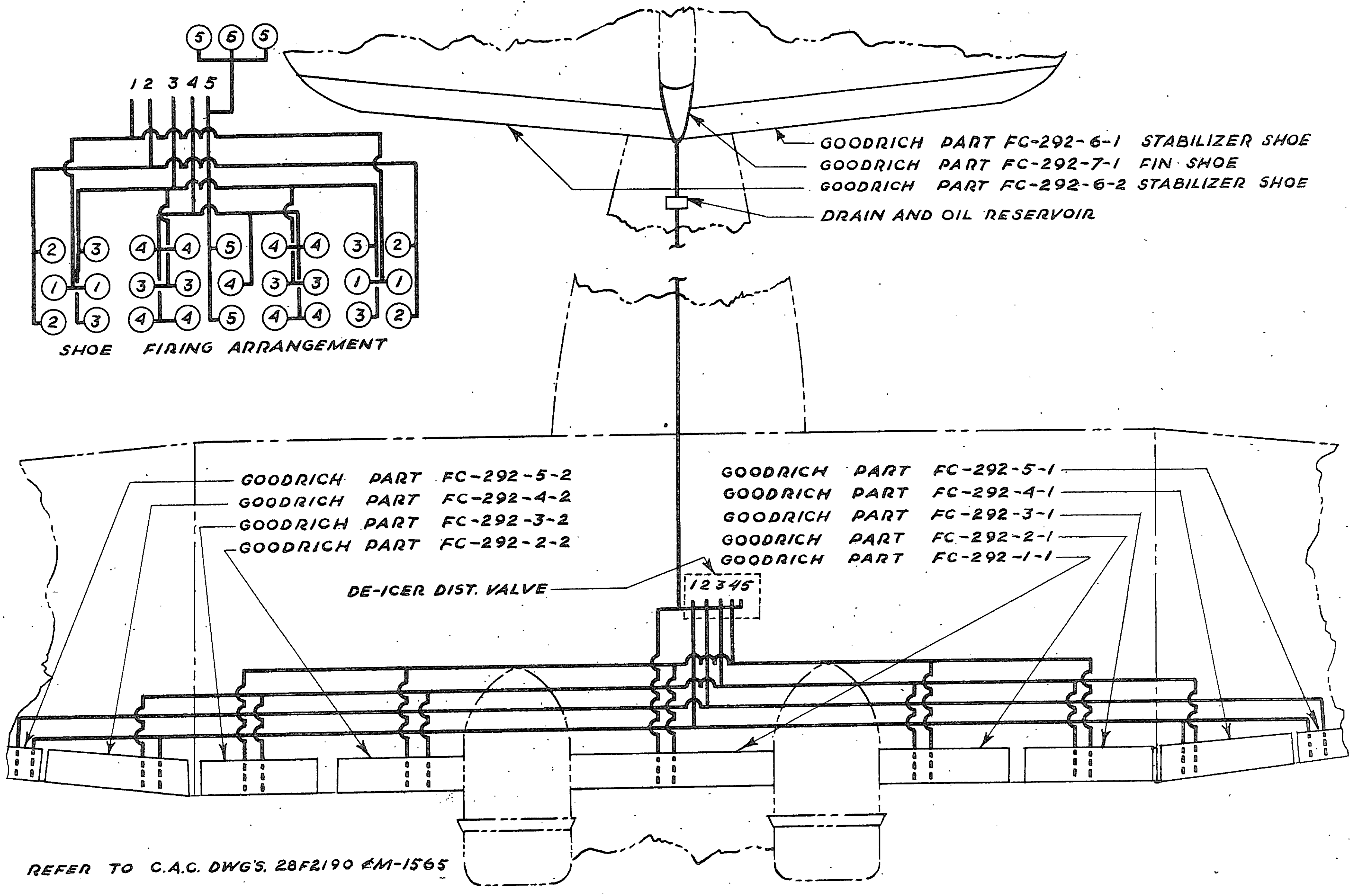
When not in use, the rear entrance ladder is stowed on the starboard side of the ship between stations #6 and #6.6. The hooks engage in slots in stowage brackets at the chine. The ladder lies over supports near the center of the ladder and is held down by a strap.

### 3. Portable Fire Extinguisher

Brackets in this airplane carry one five pound $CO_2$ portable extinguisher and three $CO_2$ hand fire extinguishers of 2 pounds capacity each.

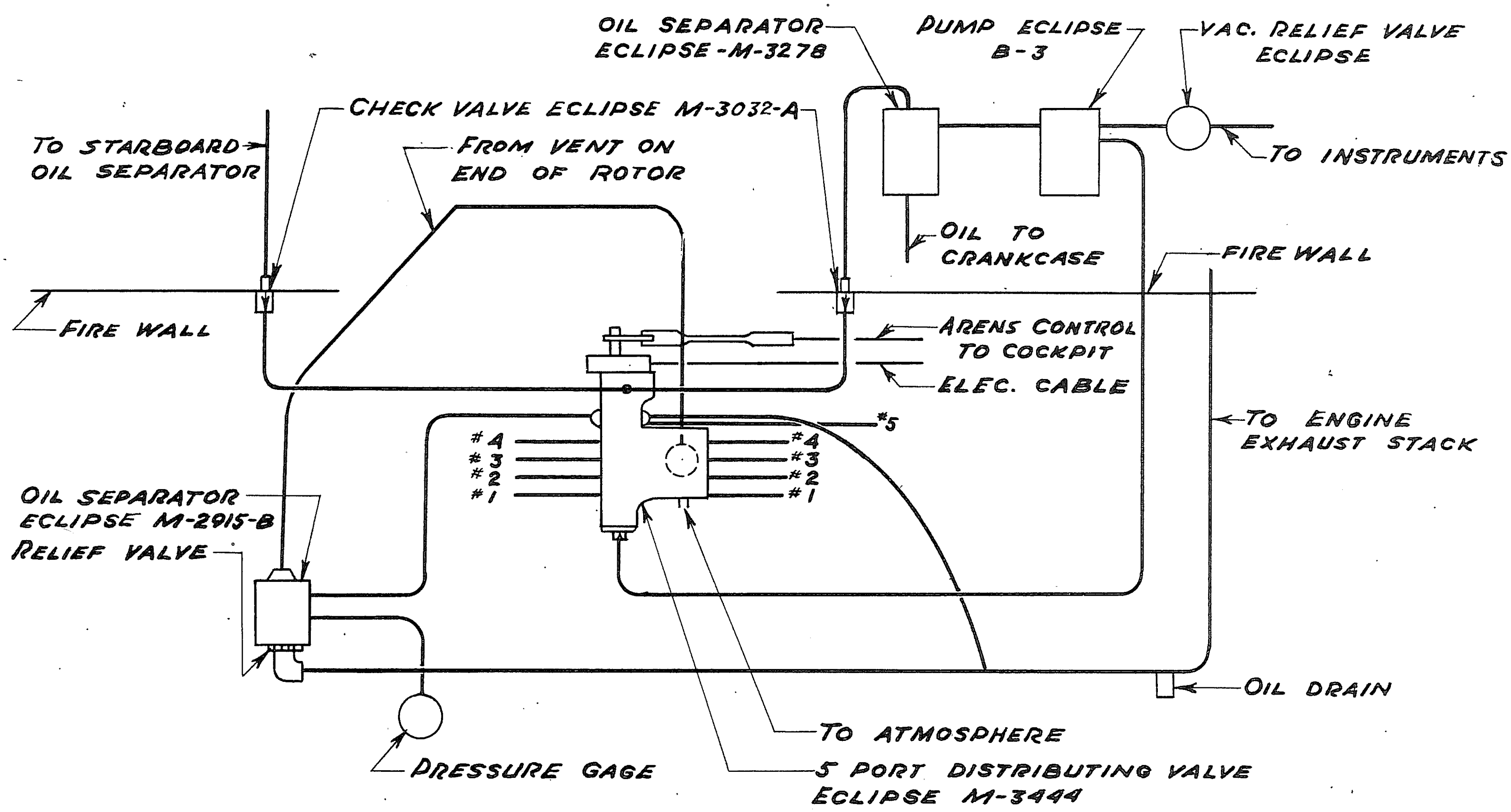
The portable $CO_2$ bottle is carried in a bracket on the forward face, port side of bulkhead #4. Instructions for operation and maintenance are given on the nameplate on the extinguisher.

One portable hand fire extinguisher is carried on the aft face of bulkhead #6 just below the door. (Ref. C.A.C. Drawing 28F5029). Another is located below the door on the forward face of bulkhead #2. (Ref. C.A.C. Drawing 28F4154). The third hand extinguisher is carried on the forward face of bulkhead #5. (Ref. C.A.C. Drawing 28F4065).



REFER TO C.A.C. DWG'S. 28F2190 & M-1565

FIGURE 87
DE-ICER SYSTEM DIAGRAM



REFER TO C.A.C. DWG'S.
28F2193 & M-1565

FIGURE 88
DE-ICER PIPING DIAGRAM

### 4. Toilets and Relief Tubes (Ref. C.A.C. Dwg. 28F4084)

A dry toilet and relief tube are provided in the rear gun compartment just forward of bulkhead #7.0. Waterproof toilet bags are provided for use with the toilet. The bags are stowed on the starboard side of the compartment.

### 5. Log Book and Maintenance Manual Stowage

The log book and maintenance manuals are contained in canvas pockets, appropriately stenciled.

### 6. Covers

Canvas covers are furnished for the pilot's enclosure and the bow gun turret.

### 7. Bal-O-Dial

#### a. Description

The Bal-O-Dial consists mechanically of four elements: a large dial, two concentric smaller dials mounted on either face of the large dial, and a transparent radial index arm assembly with radial reference lines on either side. All elements have a common center and are capable of being rotated relative to one another.

#### b. Function

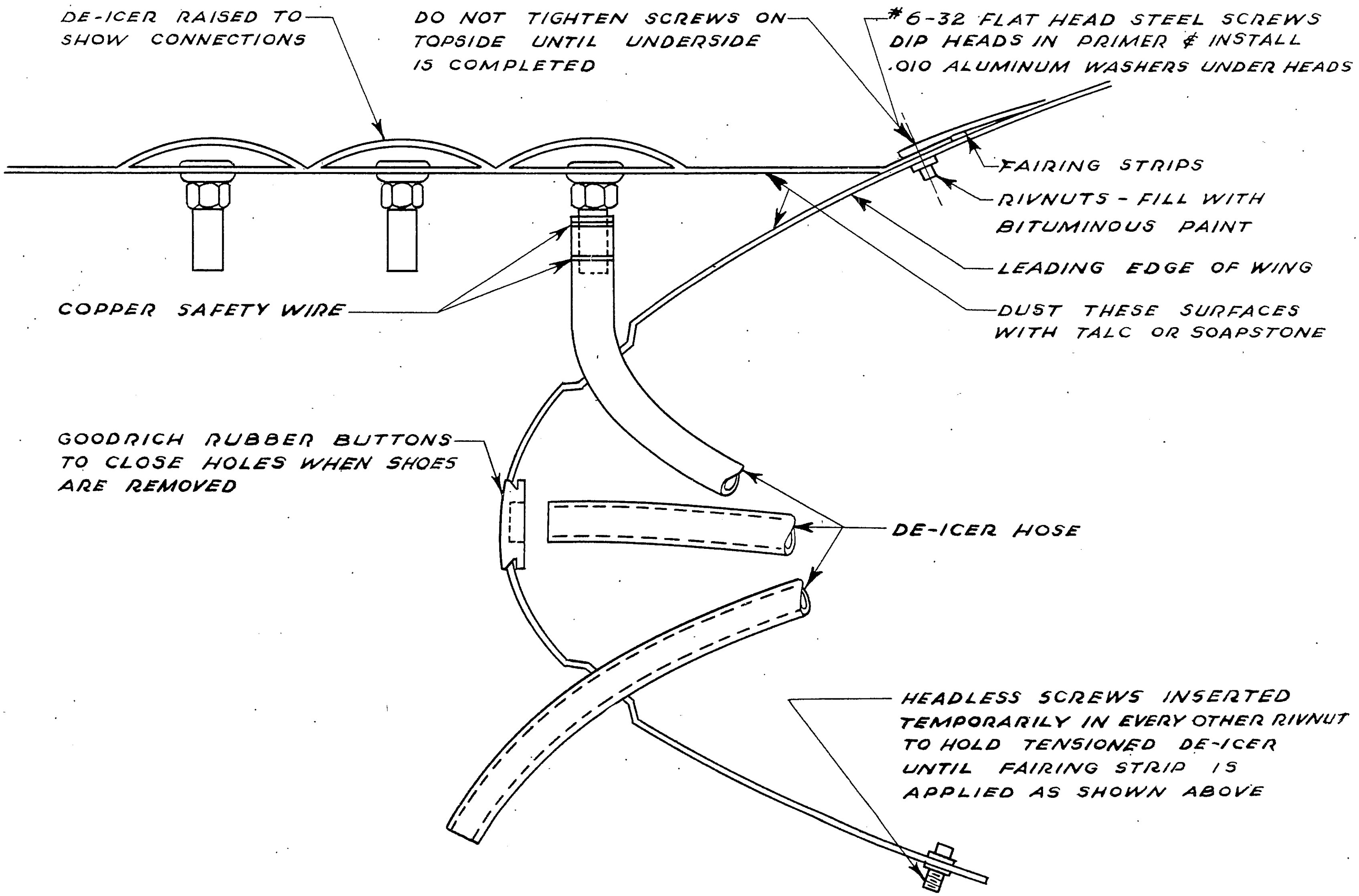
The Bal-O-Dial is used for the rapid calculation of gross weights and C. G. locations for various loading conditions. Use of the device reduces the time necessary for the above calculations from half an hour or more to a few minutes.

The Bal-O-Dial is stowed in the pilot's compartment. Accompanying it is a book of instructions for its use. One may become proficient in the use of the Bal-O-Dial with approximately half an hours practice.

## Y. Wing De-Icer Equipment (Ref. C.A.C. Dwg. 28F2190)

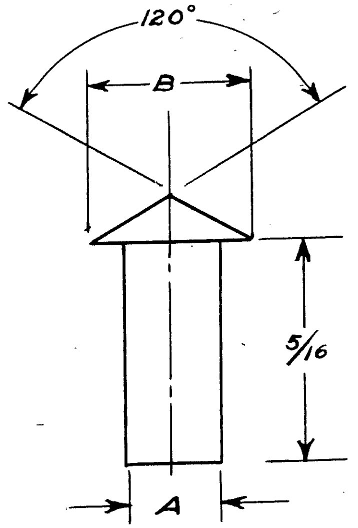
### 1. Description (See Figures 87 - 88 ).

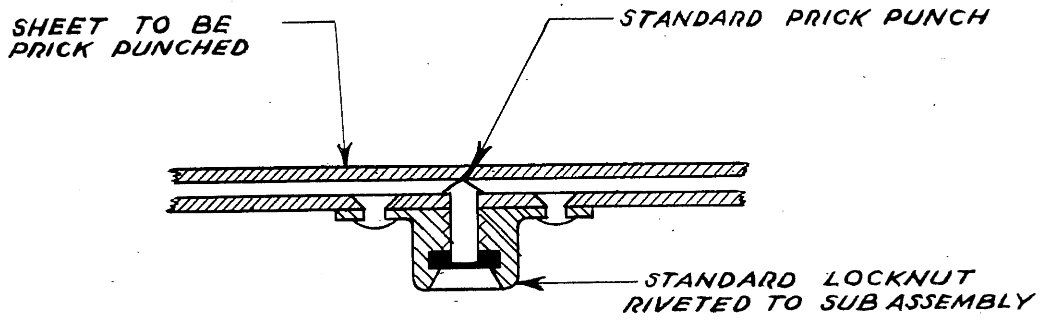
This system is comprised of wing and tail shoes, one distributor valve and an oil separator in the leading edge of the wing center section near the centerline, and one oil separator, a check valve and a suction relief valve in each nacelle. Air pressure for operating the system is provided from the pressure side of the nacelle vacuum pumps. These pumps also operate the gyroscopic instruments. The distributor valve control is located on the ceiling of the pilot's compartment between the two pilots. The pressure gage is located on the pilot's instrument panel. The switch for operating the distributor valve motor is mounted on the main distribution panel.


DE-ICER RAISED TO SHOW CONNECTIONS
DO NOT TIGHTEN SCREWS ON TOPSIDE UNTIL UNDERSIDE IS COMPLETED
*6-32 FLAT HEAD STEEL SCREWS DIP HEADS IN PRIMER ¢ INSTALL .010 ALUMINUM WASHERS UNDER HEADS
FAIRING STRIPS
RIVNUTS - FILL WITH BITUMINOUS PAINT
LEADING EDGE OF WING
DUST THESE SURFACES WITH TALC OR SOAPSTONE
COPPER SAFETY WIRE
GOODRICH RUBBER BUTTONS TO CLOSE HOLES WHEN SHOES ARE REMOVED
DE-ICER HOSE
HEADLESS SCREWS INSERTED TEMPORARILY IN EVERY OTHER RIVNUT TO HOLD TENSIONED DE-ICER UNTIL FAIRING STRIP IS APPLIED AS SHOWN ABOVE

REFER TO. C.A.C. DWG'S,
28F2190 ¢ 28W2050

FIGURE 89
ATTACHMENT OF DE-ICER SHOE




SHEET TO BE PRICK PUNCHED
STANDARD PRICK PUNCH
STANDARD LOCKNUT RIVETED TO SUB ASSEMBLY

METHOD OF USING

| STANDARD TOOL NO. | STANDARD LOCKNUT | A | B |
|---|---|---|---|
| 1J-1312-1 | 6 - 32 | .102 | 3/16 |
| -2 | 8 - 32 | .130 | 3/16 |
| -3 | 10-32 | .160 | 1/4 |
| -4 | 1/4-28 | .210 | 5/16 |

FIGURE 90
LOCATING HOLES WITH PRICK PUNCH

Access to the distributor valve and the oil separator, which are located in the leading edge of the wing, is provided through a door on the upper surface, shown on Figure 13. The distributor valve is operated by an electric motor and distributes air to each of the five de-icer groups in turn as shown by the Piping Diagram, Figure 88.

The suction relief valves, installed near the inlets to the vacuum pumps, supply the air required by the de-icer system, in excess to that furnished through the vacuum operated instruments and the instrument relief valves at the pilot's panel.

The oil separators at the engine remove most of the oil which enters the system through the vacuum pumps.

The oil separator with relief valve, used in conjunction with the distributor valve, removes all oil possible from the air going to the boots. Air flows through the separator only when the de-icer system is in operation.

The check valves at the firewall prevent air from one pump being forced back through the other pump to the instruments. This would occur if one pump failed or if an engine should be stopped.

The oil drain is located in the exhaust line just aft of the firewall in the right hand nacelle.

The de-icer system piping is of aluminum alloy tubing and incorporates bulkheads or hose connectors at all points where the lines have to be broken when disassembling. A drain line in the tail near bulkhead #8.0 leads vertically down to a can in the lower portion of the hull.

## 2. Installation

Make line connections in accordance with C.A.C. Drawings 28F2190, 28F2193, and M-1565.

To install the de-icer shoes proceed as follows: (See Figure 89 ).

Force a small amount of bituminous paint into each "rivnut" by means of a grease gun. Cut off the heads of some 6-32 x 1-1/4 long machine screws. Turn one of these screws into a "rivnut" every 3 or 4 feet on the upper surface of the airfoil. Position the de-icer and slip it over these studs. Install the correct fairing strip over the studs. Dip heads of the attaching screws (#6-32 x 1/2 flat head) in primer. Install the screws using .010 aluminum washers under the heads. Tighten the screws just enough to hold de-icer, using a blunt screw driver to prevent cutting the de-icer shoes in case the screw driver slips. Hold back the de-icer shoe and dust under the surface of the boot and adjacent surface of the wing or tail with talc or soapstone. Connect the de-icer tubes to their respective air supply lines. The line with the single outlet connects with the center fitting and the line with the double outlet connects to outside fittings. See Figure 88

The same method of installation is to be used on the screws installed in the lower surfaces.

Since the de-icer shoe is to be pulled tightly over the surface, it will be necessary to insert one of the temporary studs in every second "rivnut" on the under surface while one man pulls the rubber down over the leading edge with his open hand against the surface of the rubber. A second man can grasp the shoe and hook it into position over one stud after another, pushing it down against the skin to prevent bending the studs. Next, install the fairing strips over the studs and put screws in the intervening "rivnuts" The studs shall then be replaced by screws and all the screws tightened so that the front edge of the fairing strip imbeds itself in the rubber. De-icer fairing strips need not be continued under the regular fillets; 1/2" washers may be used instead.

### 3. Adjustment

The suction relief valve near the inlet to the vacuum pumps should be set to open at approximately 6 inches of mercury suction. The relief valves at the pilot's panel should then be checked with motors running at minimum crusing speed to insure that a little air is admitted when the instruments are operating under the correct suction pressure (3-1/2 inches of mercury).

The adjustable relief valves on the bottom of the oil separator used in connection with the distributor valve, should be set to maintain a pressure of approximately 6 lbs. on the pressure gage on the pilot's instrument panel. This pressure at the separator has been found to produce satisfactory operation of the de-icer shoes. The gage should build up to approximately 6 lbs. pressure with the inflation of each of the de-icer groups.

### 4. Operation

Move the "DE-ICER" switch on the main distribution panel to "ON" position. Pull the de-icer control located on the ceiling of the pilot's compartment.

### 5. Removal

When removing the shoes, disconnect the rubber hose from the shoes and push them through the holes in the leading edge of the wing and cover the holes with Goodrich rubber buttons. The buttons used on the stabilizer incorporate stems over which the tubes shall be placed when the shoes are removed. After the shoes and fairing strips have been removed, the "rivnuts" in the leading edge should be covered with a strip of pre-doped tape applied with clear lacquer and painted to match the adjacent surfaces.

### 6. Maintenance

The drain plug in the exhaust line (located just aft of the firewall in the right hand nacelle) should be removed to permit drainage of the lines at every 30-hour inspection. The oil can at the bottom of tail line drain shall be emptied at the same time.

A ground check should be made at least every 60-hours or more often if any malfunctioning of the system is noted. The procedure for ground checking and maintenance of the boots is covered in Goodrich De-Icer Bulletin #109.

## Z. Pitot Static Tube (Ref. C.A.C. Dwg. 28F2021)

The pitot tube is located on the leading edge of the port wing near the splice line. The tube is connected to the pilot's engineer's bomber's and navigator's instrument panels by the instrument lines shown on Figure 45 .

The head of the pitot static tube is electrically heated.

## A-A Windows and Windshields

### 1. Cleaning of Plexiglas

Use a very soapy solution by dissolving a small quantity of "Dreft", "Drene", or equivalent non-alkaline soap, in water. Wash carefully with a soft cloth, rinsing with clean water and finally drying.

If minor scratches are present, use Simonize Cleaner, or equivalent as a polish. Apply polish with a damp, soft cloth, and rub vigorously over the scratched area only. Caution must be taken not to rub in one place for any length of time, as friction will build up heat and cause ridges. Rub in the direction of and at right angles to the scratch. Several applications of Kleener may be necessary. When scratches have been obliterated, remove Kleener with a damp soft cloth.

After washing or removing scratches, the surface should always be polished with Simonize Polish, or the equivalent. Use about a half yard of cloth. Wet it, wring it out almost dry, and fold it into a pad, approximately 6 inches square. Apply the polish to the surface, evenly and thoroughly, let it dry a few seconds and then rub lightly with a dry, soft cloth.

Polishing cloths should be clean, soft and grit free. New cloths should be washed with soap and clean water. Rinse thoroughly, and dry in a dust-free room.

It is not necessary to remove transparent sheets from frames when cleaning and polishing.

### 2. Replacement of Pilot's Windshield Glass

The curved portions of the pilot's windshield plexiglas vary slightly in curvature. This makes it necessary, when replacing the panels to use the following procedure:

a. Remove the removable portion of the window frame and the old plexiglas.

b. Try the new plexiglas (without liner) in the channel to see if it fits the curve. Rework curvature of channel until plexiglas fits anugly. (The channel has been fabricated of soft material to permit bending).

c. Install .095" "Everseal" tape or the equivalent, around the edges of the plexiglas with "Vulcalock" cement or the equivalent.

d. Install plexiglas in channel with "Weatherstrip EC-31" cement, or the equivalent. Remove excess cement which has exuded around the channel.

e. Seal the channel and plexiglas with "Bostik" cement, or the equivalent. After sealer has dried thoroughly, approximately two weeks, it should be forced deeper into the channel with a piece of wood and resealed.

### 3. Resealing Pilot's Windshield

Resealing the pilot's windshield is accomplished by forcing the sealer as far into the channel as possible, with a strip of wood and resealing with "Bostik" cement, or the equivalent.

## B-B. Waist Gun Blisters (Ref. C.A.C. Dwg. 28A4006)

### 1. Description

Two tear drop turrets are provided in the aft portion of the hull between stations #6.0 and #7.0, on each side of the airplane. The turrets are formed of plexiglas with aluminum alloy framing.

Each turret houses a Cal. .50 machine gun and has two shields. The outer shield is permanently fixed to the hull and is stationary. The inner shield can be rotated in order to permit firing of the machine guns. The rotating shield also allows access to and from the airplane by use of the rear entrance ladder. Access to the shield lock, from outside the airplane, is through an access door provided in the hull just aft of the port turret. No door is provided on the starboard side. See Figure 21.

The outer rotating shield is equipped with a waterseal. The waterseal consists of a pneumatic gasket (28A5061) extending around the outside edge of the shield. A valve mechanism and hand pump are provided just aft of the turret.

## 2. Operation

The locking handle incorporates a cam upon which rides the plunger of the gasket outlet valve, and a sector with an elongated slot which actuates a locking bolt to retain the outer and inner rotating shield in a closed position. When the handle is in the unlocked position the outlet valve is held open. With the handle in the locked position the valve is closed. The last 10° movement of the handle throws the locking bolt into the locked position. The same holds true when the handle is unlocked, the last 10° movement releases the locking bolt.

The gasket should be inflated before take-off and landings and after operation of the turrets with at least 50 to 60 strokes of the hand pump.

The procedure for operating the turrets as a hatch for ingress or egress to and from the airplane is as follows:

### a. To Open the Shield

(1) Unlock the access door at the rear of the turret on the port side by operating the latch handle.

(2) Release the locking handle and wait approximately 30 seconds before raising the shield, to allow all air to escape from the gasket.

### b. To Close the Shield

(1) Close the shield.

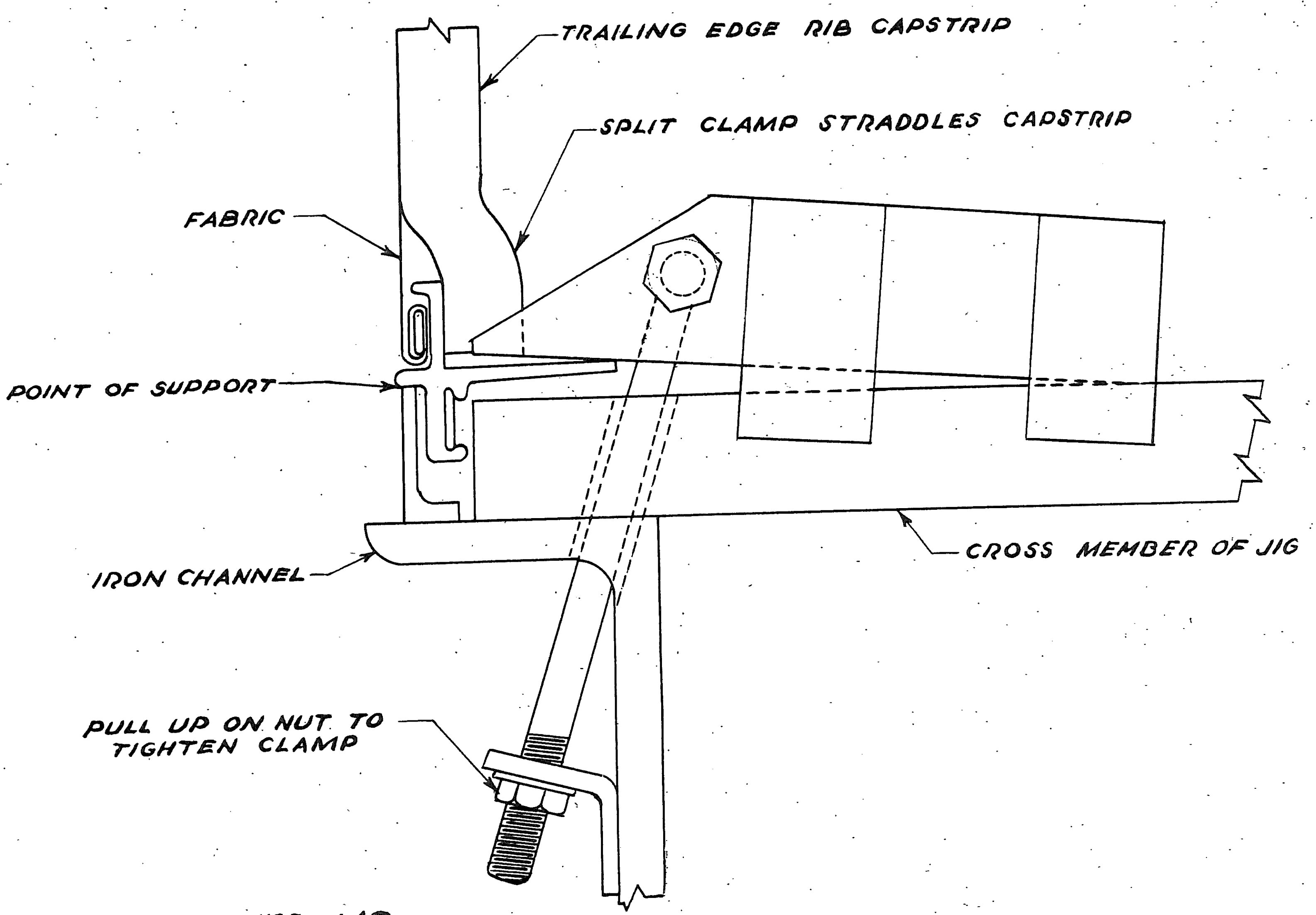
(2) Lock the shield with the locking handle.

(3) Remove the pump and give 50 to 60 full strokes.

(4) Close the access door and lock it.

## 3. Maintenance

In order to obtain the highest maintenance efficiency the waterseal gasket should be deflated and inflated at least once every 48 hours. To insure long life in service, the gasket should be periodically dusted with soapstone and the pump should be disassembled and the leather washer thoroughly lubricated.


TRAILING EDGE RIB CAPSTRIP
SPLIT CLAMP STRADDLES CAPSTRIP
FABRIC
POINT OF SUPPORT
CROSS MEMBER OF JIG
IRON CHANNEL
PULL UP ON NUT TO TIGHTEN CLAMP

NOTE: SEE ALSO FIGURE 149

FIGURE 91
CLAMPING TRAILING EDGE IN DOPING JIG

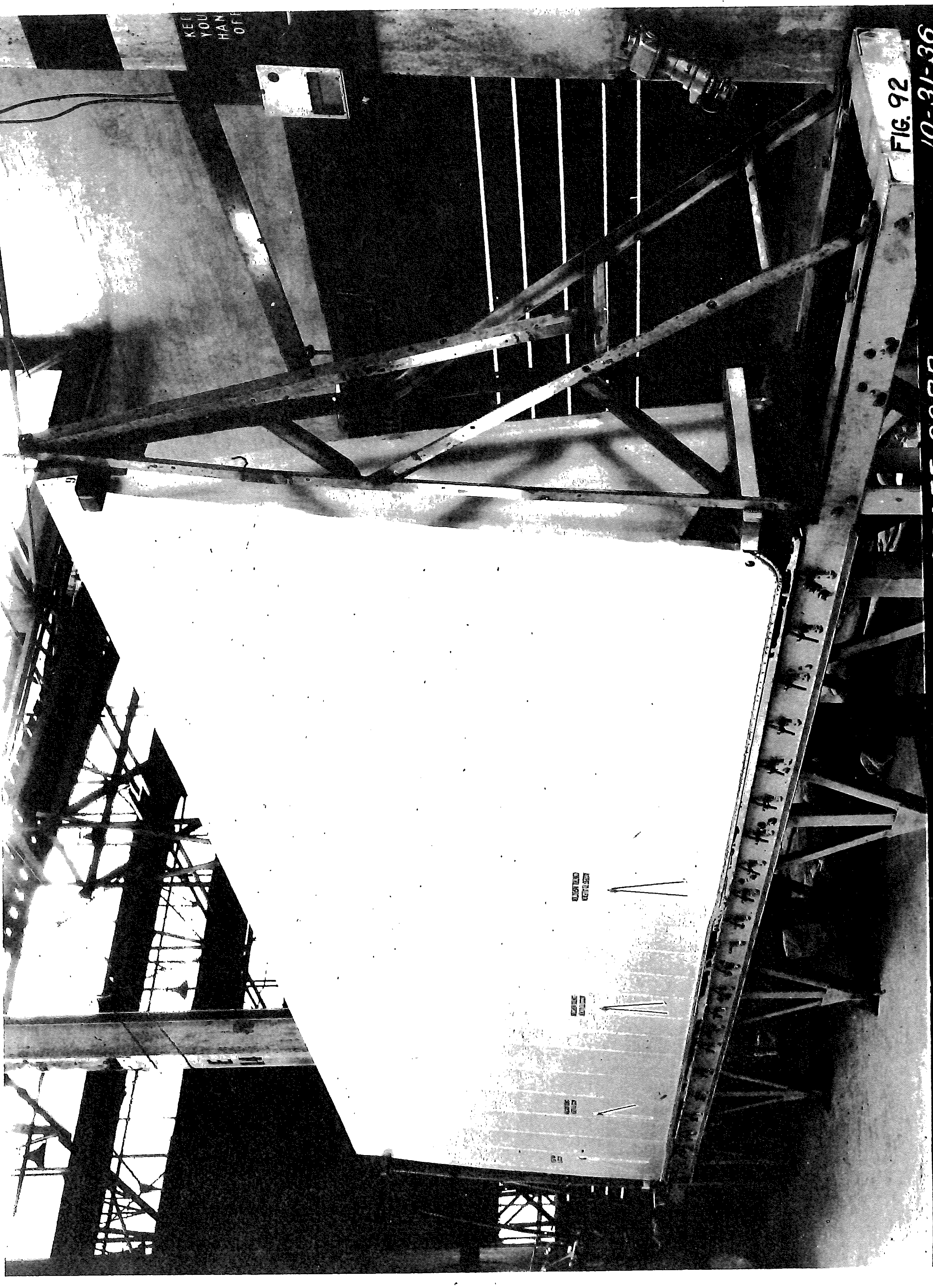


FIG. 92

10-31-36

CONSOLIDATED AIRCRAFT CORP.
WING CENTER SECTION TRAILING
EDGE ON DOPING FIXTURE

NO. 3066

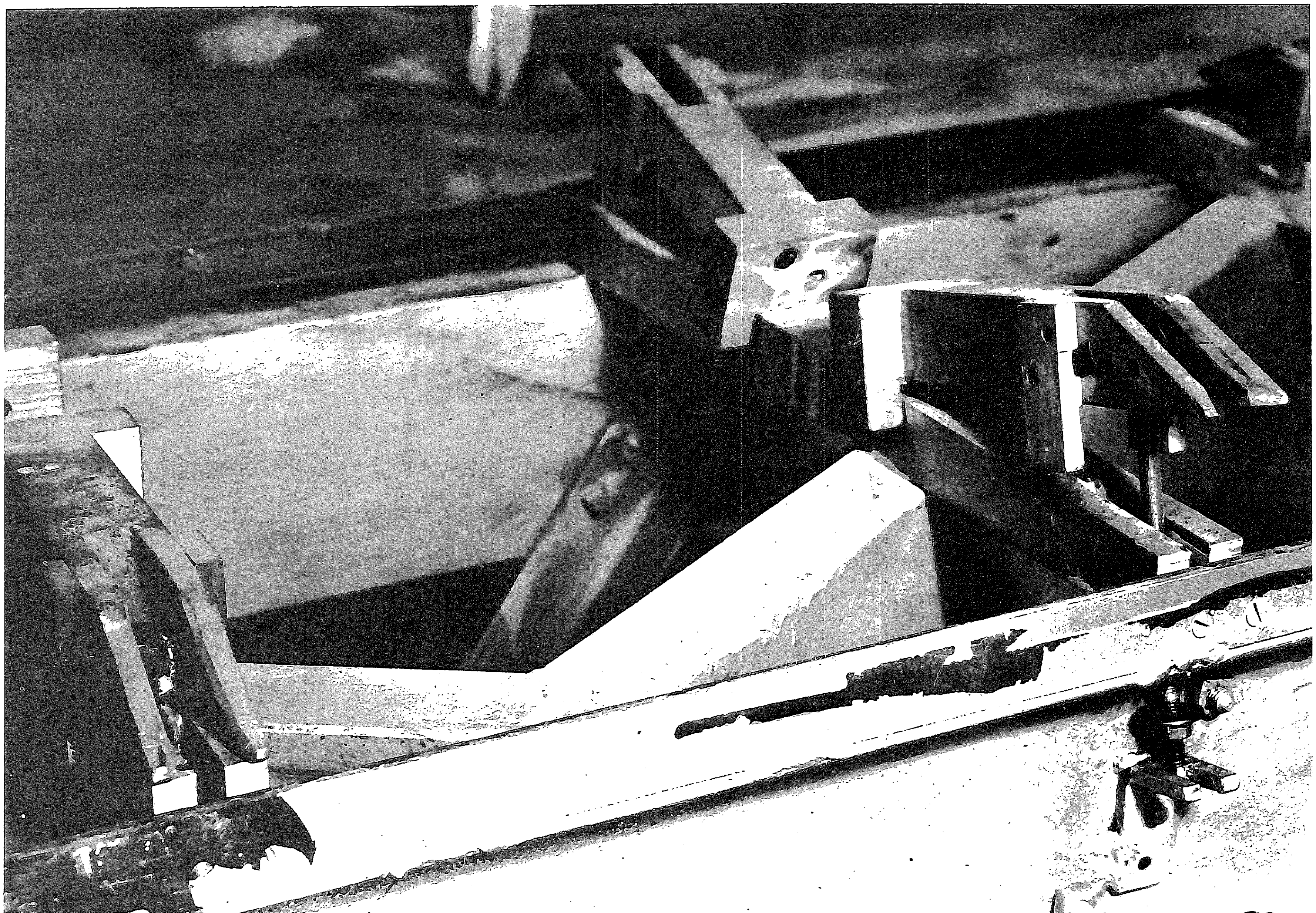


FIG. 93

NO. 3067 CONSOLIDATED AIRCRAFT CORP. 10-31-36
DETAIL OF CLAMPS ON WING CENTER
SECTION TRAILING EDGE DOPING FIXTURE

## SECTION V

## USEFUL LOAD

A. **Weight Distribution** (From Weight and Balance Report ZW-28-060)

| | | Weight | Horizontal Arm |
|---|---|---|---|
| **785 Gal. Patrol - Crew Functional** | | | |
| **Crew and Life Jackets** (7) | | | |
| Pilot | | 180.0 | 108.0 |
| Assistant Pilot | | 180.0 | 108.0 |
| Navigator | | 180.0 | 187.0 |
| Radio Operator | | 180.0 | 199.0 |
| Mechanic | | 180.0 | 255.0 |
| Bunk Station #5 - #6 (2) | | 360.0 | 344.0 |
| Total Crew and Life Jackets | | (1260.0) | (220.7) |
| **Parachutes** (7) | | | |
| Aft Bulkhead #2 (2) | | 40.0 | 136.0 |
| On Bulkheads #4 (1) | | 20.0 | 231.0 |
| On Bulkhead #5 (2) | | 40.0 | 302.0 |
| On Bulkhead #2 (2) | | 40.0 | 123.0 |
| Total Parachutes | | ( 140.0) | (193.3) |
| **Fuel** - 800 Gals. @ 6# | | | |
| 400 Gals. Fuel in Integral Tank | | 2400.0 | 270.5 |
| 400 Gals. Fuel in Self-Sealing Fuel Cells | | 2400.0 | 269.3 |
| * Total Fuel | | (4800.0) | (269.9) |
| Oil - 50 Gals. @ 7.5# | | 375.0 | 208.0 |
| **Armament** | | | |
| **Flexible Gun Installation** | | | |
| **Bow Gun Installation** | | | |
| .30 Cal. M-2 Gun | (1) | 21.5 | 23.5 |
| Ring Sight, Mk. VIII | (1) | .4 | 14.5 |
| Fore Post Sight, Mk. V | (1) | .4 | 1.0 |
| Ejected Link Container, Mk. V | (1) | 1.3 | 23.5 |
| Ejected Case Container, Mk. III-1 | (1) | 1.6 | 23.5 |
| Gun Mount Adapter, Mk. IX | (1) | 3.8 | 24.0 |
| 1000 Rds. Ammunition | | 80.0 | 26.7 |
| Total Bow Gun Installation | | ( 109.0) | ( 25.8) |

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| | | Weight | Horizontal Arm |
|---|---|---|---|
| 785 Gal. Patrol - Crew Functional (Cont'd.) | | | |
| Armament (Cont'd.) | | | |
| Flexible Gun Installation (Cont'd.) | | | |
| Waist Gun Installation | | | |
| .50 Cal. M-2 Guns | (2) | 118.7 | 422.8 |
| Telescope Sights, Mk. V-1 | (2) | 3.0 | 432.0 |
| Gun Mount Adapters | (2) | 46.8 | 426.8 |
| 840 Rds. Ammunition with Links including 14 60-Rd. Magazine Assemblies, Mk. V | | 317.3 | 425.0 |
| Retracting Slide Group Assembly | | 6.2 | 427.0 |
| Total Waist Gun Installation | | (492.0) | (424.7) |
| Tunnel Gun Installation | | | |
| .30 Cal. M-2 Gun | (1) | 21.5 | 551.0 |
| Ring Sight, Mk. VIII | (1) | .4 | 556.0 |
| Post Sight, Mk. V | (1) | .4 | 572.0 |
| Ejected Link Container, Mk. V | (1) | 1.3 | 551.0 |
| Ejected Case Container, Mk. III-1 | (1) | 1.6 | 551.0 |
| Gun Mount Adapter, Mk. IX | (1) | 3.8 | 551.0 |
| 500 Rds. Ammunition with Links in Magazine Assy., Mk. I | | 40.0 | 537.0 |
| Total Tunnel Gun Installation | | (69.0) | (543.0) |
| Total Flexible Guns | | 670.0 | 372.0 |
| Pyrotechnics | | | |
| Very's Pistol Installation | | | |
| Very's Pistol - Pilot's (1) | | 2.5 | 95.5 |
| Very's Pistol - Waist Gun Compartment | (1) | 2.5 | 386.0 |
| Ammunition - Pilot's, 24 Rds. | | 2.9 | 109.0 |
| Ammunition - Waist Gun Compartment, 24 Rds. | | 2.9 | 386.0 |
| Total | | (10.8) | (244.4) |
| Flare Installation | | | |
| Flares Near Containers | (2) | 40.0 | 511.0 |
| Flares in Rack | (6) | 120.0 | 155.0 |
| Total Flares | | (160.0) | (244.0) |
| Float Lights | (18) | 39.6 | 490.0 |
| Smoke Grenades | (2) | 3.6 | 386.0 |
| Total Pyrotechnics | | (214.0) | (291.9) |
| Total Armament | | 884.0 | 352.6 |

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| 785 Gal. Patrol - Crew Functional (Cont'd.) | Weight | Horizontal Arm |
|---|---|---|
| **Equipment** | | |
| **Radio** | | |
| ** Main Unit | 218.8 | 176.1 |
| ** Intersquadron Unit | 116.6 | 173.1 |
| ** Interphone Unit | 38.6 | 190.0 |
| ** Direction Finding Loop | 15.8 | 210.0 |
| ** ZA Landing Equipment | 36.3 | 185.0 |
| ** Fixed Antenna and Insulators | 6.9 | 270.6 |
| ** Removable Cables for Radio Equipment | 13.7 | 175.0 |
| Total Radio | ( 446.7) | (179.9) |
| **Navigating** | | |
| Pelorus Sight, Mk. II-C & Bases (4) | 5.0 | 208.0 |
| Binoculars (2) | 5.3 | 124.0 |
| Miscellaneous Charts, Etc. | 5.0 | 154.0 |
| Chart Board, Mk. V-A | 3.0 | 109.0 |
| Protractor, Mk. III | 5.1 | 200.0 |
| Books | 2.0 | 218.0 |
| Driftsight, Mk. VII | 18.0 | 187.0 |
| Sextant and Cases | 6.5 | 197.0 |
| Navigating Watches (2) | 3.3 | 196.0 |
| Total Navigating | ( 53.2) | (179.4) |
| **Miscellaneous** | | |
| ** Tool Kit | 13.4 | 283.0 |
| ** First Aid Kit | 1.7 | 384.0 |
| Food | 140.0 | 196.0 |
| Water | 140.0 | 180.0 |
| Flash Lights and Batteries | 7.8 | 283.0 |
| ** Canvas Bucket | 2.1 | 270.0 |
| Life Raft, Mk. VII | 64.0 | 467.0 |
| ** Rope - 300 feet | 22.3 | 270.0 |
| ** Buoy Hook and Rope | 4.9 | 62.0 |
| ** Engine Tool Kit | 12.2 | 283.0 |
| ** Boat Hook | 4.0 | 305.0 |
| Spot Light, Case and Base | 9.0 | 69.0 |
| Bedding, Etc. (7) Men | 35.0 | 265.0 |
| Personal Effects (7) Men | 70.0 | 265.0 |
| Oxygen Equipment | 340.8 | 242.4 |
| Auxiliary Power Unit Oil - 2 Gal. | 15.0 | 255.0 |
| Auxiliary Power Unit Fuel (included in Main Fuel) | --- | --- |
| Total Miscellaneous | ( 882.2) | (244.4) |
| Total Equipment | 1382.1 | 221.1 |
| Total Useful Load | 8841.1 | 259.7 |

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## 1463 Gal. Patrol - Crew Functional Full Fuel with Self-Sealing Cells on One Side Only -

| | | Weight | Horizontal Arm |
|---|---|---|---|
| Crew and Life Jackets | (7) | 1260.0 | 220.7 |
| Parachutes | (7) | 140.0 | 193.5 |
| * Fuel - 1478 Gals. @ 6# | | | |
| 603 Gals. Fuel in Self Sealing Cells | | 3618.0 | 266.6 |
| 875 Gals. Fuel in Integral Tanks | | 5250.0 | 266.6 |
| *** Total Fuel | | (8868.0) | (266.6) |
| Oil - 92 Gals. @ 7.5# | | 690.0 | 208.0 |
| Armament | | 884.0 | 352.6 |
| Equipment | | 1382.0 | 221.1 |
| Total Useful Load | | 13,224.0 | 259.4 |

## 500 Gal. Bomber (2) 1000# Bombs - Crew Functional

| | | Weight | Horizontal Arm |
|---|---|---|---|
| Crew and Life Jackets | (7) | 1260.0 | 220.7 |
| Parachutes | (7) | 140.0 | 193.3 |
| Fuel - 515 Gals. @ 6# | | | |
| 257.5 Gals. Fuel in Integral Tank | | 1545.0 | 272.3 |
| 257.5 Gals. Fuel in Self-Sealing Cells | | 1545.0 | 270.7 |
| * Total Fuel | | (3090.0) | (271.5) |
| Oil - 35 Gals. @ 7.5# | | 262.5 | 208.0 |
| Armament | | | |
| Flexible Guns | | 670.0 | 372.0 |
| Pyrotechnics | | 214.0 | 291.9 |
| Bombing Installation | | | |
| 1000# Bombs | (2) | 2000.0 | 249.0 |
| Bomb Racks, Mk. XXXV | (4) | | |
| and Solenoids, Mk. XVII-1 | (4) | 92.0 | 250.0 |
| Bombsight, Mk. IV | (1) | 35.0 | 15.0 |
| Pilot Direction Indicators | (2) | 1.2 | 72.0 |
| Firing Key NA-41A | (1) | 1.3 | 17.0 |
| Sets Bomb Chocks | (2) | 10.4 | 250.0 |
| Total Bombing Installation | | (2139.9) | (245.0) |
| Total Armament | | 3023.9 | 276.4 |
| Total Equipment | | 1382.1 | 221.1 |
| Total Useful Load | | 9158.5 | 255.5 |

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| | | Weight | Horizontal Arm |
|---|---|---|---|
| 500 Gal. Bomber (4) 1000# Bombs - Crew Functional | | | |
| Crew and Life Jackets | (7) | 1260.0 | 220.7 |
| Parachutes | (7) | 140.0 | 193.3 |
| Fuel - 515 Gals. @ 6# | | | |
| 257.5 Gals. Fuel in Integral Tank | | 1545.0 | 272.3 |
| 257.5 Gals. Fuel in Self-Sealing Cells | | 1545.0 | 270.7 |
| * Total Fuel | | (3090.0) | (271.5) |
| Oil - 35 Gals. @ 7.5# | | 262.5 | 208.0 |
| Armament | | | |
| Flexible Guns | | 670.0 | 372.0 |
| Pyrotechnics | | 214.0 | 291.9 |
| Bombing Installation | | | |
| 1000# Bombs | (4) | 4000.0 | 249.0 |
| Bomb Racks, Mk XXXV | (4) | | |
| and Solenoids, Mk. XVII | (4) | 92.0 | 250.0 |
| Bombsight, Mk. XV-4 | (1) | 35.0 | 15.0 |
| Pilot Director Indicator | (2) | 1.2 | 72.0 |
| Firing Key NA-41A | (1) | 1.3 | 17.0 |
| Sets Bomb Chocks | (2) | 10.4 | 250.0 |
| Total Bombing Installation | | (4139.9) | (246.9) |
| Total Armament | | 5023.9 | 265.5 |
| Total Equipment | | 1382.1 | 221.1 |
| Total Useful Load | | 11,158.5 | 254.3 |

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| | | Weight | Horizontal Arm |
|---|---|---|---|
| **500 Gal. Bomber (12) 100# Class (116#) Bombs - Crew Functional** | | | |
| Crew and Life Jackets | (7) | 1260.0 | 220.7 |
| Parachutes | (7) | 140.0 | 193.3 |
| **Fuel** - 515 Gals. @ 6# | | | |
| 257.5 Gals. Fuel in Integral Tank | | 1545.0 | 272.3 |
| 257.5 Gals. Fuel in Self-Sealing Cells | | 1545.0 | 270.7 |
| * Total Fuel | | (3090.0) | (271.5) |
| Oil - 35 Gals. @ 7.5# | | 262.5 | 208.0 |
| **Armament** | | | |
| Flexible Guns | | 670.0 | 372.0 |
| Pyrotechnics | | 214.0 | 291.9 |
| **Bombing Installation** | | | |
| 116# Bombs | (12) | 1392.0 | 263.0 |
| Bomb Racks, Mk. XLII | (4) | 208.0 | 264.0 |
| Bombsight, Mk. XV-4 | (1) | 35.0 | 15.0 |
| Firing Key NA-41A | (1) | 1.3 | 17.0 |
| Pilot Director Indicator | (2) | 1.2 | 72.0 |
| Bomb Rack Supports (External) | | 24.0 | 263.0 |
| Total Bomb Installation | | (1661.5) | (257.6) |
| Total Armament | | 2545.5 | 290.6 |
| Total Equipment | | 1382.1 | 221.1 |
| Total Useful Load | | 8680.1 | 258.5 |
| **1000 Gal. Bomber (2) 1000# Bombs - Crew Functional** | | | |
| Crew and Life Jackets | (7) | 1260.0 | 220.7 |
| Parachutes | (7) | 140.0 | 193.3 |
| **Fuel** - 1015 Gals. @ 6# | | | |
| 507.5 Gals. Fuel in Integral Tank | | 3045.0 | 269.7 |
| 507.5 Gals. Fuel in Self-Sealing Cells | | 3045.0 | 268.8 |
| * Total Fuel | | (6090.0) | (269.3) |
| Oil - 60 Gals. @ 7.5# | | 450.0 | 208.0 |
| Armament | | 3023.9 | 276.4 |
| Equipment | | 1382.1 | 221.1 |
| Total Useful Load | | 12,346.0 | 257.6 |

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## 500 Gal. Torpedo (2) Mk. XIII Torpedoes - Crew Functional

| | | Weight | Horizontal Arm |
|---|---|---|---|
| Crew and Life Jackets | (7) | 1260.0 | 220.7 |
| Parachutes | (7) | 140.0 | 193.3 |
| Fuel - 515 Gals. @ 6# | | | |
| 257.5 Gals. Fuel in Integral Tank | | 1545.0 | 272.3 |
| 257.5 Gals. Fuel in Self-Sealing Cells | | 1545.0 | 270.7 |
| * Total Fuel | | (3090.0) | (271.5) |
| Oil - 35 Gals.. @ 7.5# | | 262.5 | 208.0 |
| Armament | | | |
| Flexible Guns | | 670.0 | 372.0 |
| Pyrotechnics | | 214.0 | 291.9 |
| Torpedo Installation | | | |
| 1935# Torpedoes, Mk. XIII | (2) | 3870.0 | 247.0 |
| Starting Mechanism | (2) | 1.9 | 309.0 |
| Torpedo Propeller Stops | (2) | 0.1 | 318.0 |
| Torpedo Director, Mk. XXVIII | (1) | 3.0 | 85.0 |
| Firing Key NA-41A | (1) | 1.3 | 122.0 |
| Sets Torpedo Chocks & Supports | (2) | 317.8 | 249.0 |
| Total Torpedo Installation | | (4194.1) | (247.0) |
| Total Armament | | 5078.1 | 265.4 |
| Equipment | | 1382.1 | 221.1 |
| Total Useful Load | | 11,212.7 | 254.4 |

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| | | Weight | Horizontal Arm |
|---|---|---|---|
| **785 Gal. Patrol - Crew Battle** | | | |
| **Crew and Life Jackets** | (7) | | |
| Bomber | (1) | 180.0 | 24.0 |
| Pilot | (1) | 180.0 | 108.0 |
| Radio Operator | (1) | 180.0 | 199.0 |
| Mechanic | (1) | 180.0 | 255.0 |
| Waist Gunners | (2) | 360.0 | 427.0 |
| Tunnel Gunner | (1) | 180.0 | 523.0 |
| Total Crew and Life Jackets | | (1260.0) | (280.4) |
| Parachutes | (7) | 140.0 | 193.3 |
| **Fuel** - 800 Gals. @ 6# | | | |
| 400 Gals. Fuel in Integral Tank | | 2400.0 | 270.5 |
| 400 Gals. Fuel in Self-Sealing Cells | | 2400.0 | 269.3 |
| * Total Fuel | | (4800.0) | (269.9) |
| Oil - 50 Gals. @ 7.5# | | 375.0 | 208.0 |
| Armament | | 884.0 | 352.6 |
| Equipment | | 1382.1 | 221.1 |
| Total Useful Load | | 8841.1 | 268.2 |

| | | Weight | Horizontal Arm |
|---|---|---|---|
| **1463 Gal. Patrol - Crew Battle** | | | |
| **Full Fuel with Fuel Cells on One Side Only** | | | |
| Crew and Life Jackets | (7) | 1260.0 | 280.4 |
| Parachutes | (7) | 140.0 | 193.3 |
| * **Fuel** - 1478 Gals. @ 6# | | | |
| 875 Gals. Fuel in Integral Tank | | 5250.0 | 266.6 |
| 603 Gals. Fuel in Self-Sealing Cells | | 3618.0 | 266.6 |
| *** Total Fuel | | (8868.0) | (266.6) |
| Oil - 92 Gals. @ 7.5# | | 690.0 | 208.0 |
| Armament | | 884.0 | 352.6 |
| Equipment | | 1382.1 | 221.1 |
| Total Useful Load | | 13,224.1 | 265.1 |

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| | | Weight | Horizontal Arm |
|---|---|---|---|
| **500 Gal. Bomber (2) 1000# Bombs - Crew Battle** | | | |
| Crew and Life Jackets | (7) | 1260.0 | 280.4 |
| Parachutes | (7) | 140.0 | 193.3 |
| Fuel - 515 Gals. @ 6# | | | |
| 257.5 Gals. Fuel in Integral Tank | | 1545.0 | 272.3 |
| 257.5 Gals. Fuel in Self-Sealing Cells | | 1545.0 | 270.7 |
| * Total Fuel | | (3090.0) | (271.5) |
| Oil - 35 Gals. @ 7.5# | | 262.5 | 208.0 |
| Armament | | 3023.9 | 276.4 |
| Equipment | | 1382.1 | 221.1 |
| Total Useful Load | | 9158.5 | 263.7 |
| **500 Gal. Bomber (4) 1000# Bombs - Crew Battle** | | | |
| Crew and Life Jackets | (7) | 1260.0 | 280.4 |
| Parachutes | (7) | 140.0 | 193.3 |
| Fuel - 515 Gals. @ 6# | | | |
| 257.5 Gals. Fuel in Integral Tank | | 1545.0 | 272.3 |
| 257.5 Gals. Fuel in Self-Sealing Cells | | 1545.0 | 270.7 |
| * Total Fuel | | (3090.0) | (271.5) |
| Oil - 35 Gals. @ 7.5# | | 262.5 | 208.0 |
| Armament | | 5023.9 | 265.5 |
| Equipment | | 1382.1 | 221.1 |
| Total Useful Load | | 11,158.5 | 261.1 |
| **500 Gal. Bomber (12) 100# Class (116#) Bombs - Crew Battle** | | | |
| Crew and Life Jackets | (7) | 1260.0 | 280.4 |
| Parachutes | (7) | 140.0 | 193.3 |
| Fuel - 515 Gals. @ 6# | | | |
| 257.5 Gals. Fuel in Integral Tank | | 1545.0 | 272.3 |
| 257.5 Gals. Fuel in Self-Sealing Cells | | 1545.0 | 270.7 |
| * Total Fuel | | (3090.0) | (270.5) |
| Oil - 35 Gals. @ 7.5# | | 262.5 | 208.0 |
| Armament | | 2545.5 | 290.6 |
| Equipment | | 1382.1 | 221.1 |
| Total Useful Load | | 8680.1 | 267.2 |

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### 1000 Gal. Bomber (2) 1000# Bombs - Crew Battle

| | Weight | Horizontal Arm |
|---|---|---|
| Crew and Life Jackets (7) | 1260.0 | 280.4 |
| Parachutes (7) | 140.0 | 193.3 |
| Fuel - 1015 Gals. @ 6# | | |
| 507.5 Gals. Fuel in Integral Tank | 3045.0 | 269.7 |
| 507.5 Gals. Fuel in Self-Sealing Cells | 3045.0 | 268.8 |
| * Total Fuel | (6090.0) | (269.3) |
| Oil - 60 Gals. @ 7.5# | 450.0 | 208.0 |
| Armament | 3023.9 | 276.4 |
| Equipment | 1382.1 | 221.1 |
| Total Useful Load | 12,346.0 | 263.7 |

### 500 Gal. Torpedo (2) Mk. XIII Torpedoes - Crew Battle

| | Weight | Horizontal Arm |
|---|---|---|
| Crew and Life Jackets (7) | 1260.0 | 280.4 |
| Parachutes | 140.0 | 193.3 |
| Fuel - 515 Gals. @ 6# | | |
| 257.5 Gals. Fuel in Integral Tank | 1545.0 | 272.3 |
| 257.5 Gals. Fuel in Self-Sealing Cells | 1545.0 | 270.7 |
| * Total Fuel | (3090.0) | (271.5) |
| Oil - 35 Gals. @ 7.5# | 262.5 | 208.0 |
| Armament | 5078.1 | 265.4 |
| Equipment | 1382.1 | 221.1 |
| Total Useful Load | 11,212.7 | 261.1 |

* Includes 15 Gals. Auxiliary Power Unit Fuel

** Indicates actual Weight of These Useful Load Items

*** 1478 Gals. of Fuel Represents the Total Fuel Capacity of Goodyear Self-Sealing Fuel Cells in One Side of the Wing and Integral Tank in the Other Side of the Wing. This Includes 15 Gals. Fuel for the Auxiliary Power Unit.

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SPECIAL EQUIPMENT (When carried, should be considered overload)

| | | Weight | Horizontal Arm | |
|---|---|---|---|---|
| De-Icing Equipment | | | | |
| Wing Boots, Fairing Strips and Attaching Parts | | 75.0 | 204.0 | |
| Tail Boots, Fairing Strips and Attaching Parts | | 27.0 | 656.0 | |
| Engine Covers | (2) | 31.0 | 245.0 ) | In or near miscellaneous gear cover. |
| Pilot's Enclosure Cover | (1) | 15.0 | 245.0 ) | |
| Propeller Hub Covers | (2) | 2.4 | 245.0 ) | |
| Waist Gun Shield Covers | (2) | 18.6 | 245.0 ) | |
| Bomb Loading Platforms | (2) | 53.5 | No Stowage Location. | |
| Engine Hoist and Tackle | | 78.0 | No Stowage Location. | |
| Surface Control Lock | | 2.8 | 60.0 | |
| Propeller Hoist and Tackle | | 19.0 | No Stowage Location. | |
| *Smoke Tank Installation | | | | |
| Smoke Screen Tank, Mk. V | (1) | 975.0 | 250.0 | |
| $CO_2$ Cylinder, Mk. V | (1) | 34.0 | 250.0 | |

* The Smoke Tank Hangs from the Internal Mk. XXXV-6 Bomb Rack On The Port Side of the Ship.

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## * WEIGHT EMPTY EQUIPMENT - READILY REMOVABLE

| | | Weight | Horizontal Arm |
|---|---|---|---|
| **Miscellaneous** | | | |
| Tunnel Gunner's Pad | | 10.0 | 505.0 |
| Bomber's Pad | | 2.4 | 25.0 |
| Automatic Flight Control Motors | | 143.0 | 53.6 |
| Seat Cushions | | 34.1 | 152.0 |
| **Safety Belts** | | | |
| Pilot's Type | (5) | 14.4 | 172.0 |
| Gunner's Type | (4) | 11.3 | 318.0 |
| Bunk Belts | (4) | 4.9 | 339.0 |
| Tunnel Gunner's Safety Cable | (1) | 1.5 | 524.0 |
| Bilge Pump Hose and Stowage | | 33.6 | 274.0 |
| Entrance Ladder and Stowage | (1) | 7.8 | 447.0 |
| Work Platforms | (2) | 33.6 | 343.0 |
| Curtains (Pilot's & Navigator's) | | 4.2 | 120.0 |
| Draft Screen | | 3.9 | 59.0 |
| Mechanic's Knee Pads | | 0.5 | 245.0 |
| Percolator | (1) | 0.9 | 265.0 |
| **Fire Extinguishers** | | | |
| Engine | (1) | 31.6 | 215.0 |
| Portable | (1) | 16.6 | 225.0 |
| Hand | (3) | 19.9 | 244.0 |
| Bombsight Cover | | 5.4 | 15.0 |
| Torpedo Slings | (2) | 12.8 | 251.0 |
| Automatic Flight Control Cover | | 6.6 | 58.0 |
| Control Yoke Boots | | 0.6 | 87.0 |
| **Anchor and Handling Gear** | | | |
| Anchor | | 31.8 | 49.0 |
| Anchor Line | | 16.0 | 40.0 |
| Pendant | | 4.6 | 25.0 |
| Clamp Assembly | | 5.1 | 50.0 |
| Lizard | | 1.2 | 50.0 |
| Hoisting Sling | | 24.5 | 302.0 |
| **Fuel Protection and Armor Plating** | | | |
| **Self-Sealing Fuel Cell Installation** | | | |
| Fuel Cells | (5) | 533.0 | 269.0 |
| Interconnecting Tubing | | 25.0 | 269.0 |
| Vents and Guards | | 5.0 | 269.0 |
| Fuel Cell Liners, Wooden Backing Plates and Canvas Curtains | | 90.0 | 269.0 |

* Included in Weight Empty (19,882#) of Actual Weight and Balance Report ZW-28-060.

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## Miscellaneous (Cont'd.)

### Armor Plating - Readily Removable

| | Weight | Horizontal Arm |
|---|---|---|
| Armor Plating at Tunnel Gun | 118.9 | 539.0 |
| Armor Plating at Waist Gun Turret | 94.2 | 426.0 |
| Armor Plating for Fuel Protection | 105.0 | 285.8 |
| Armor Plating at Pilots' Seats (Est.) | 180.0 | 116.0 |
| Armor Plating at Bow Gun | 53.9 | 22.0 |

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## 100% vs 50% FUEL PROTECTION - NO FUEL PROTECTION NOR ARMOR PLATING vs 50% FUEL PROTECTION & ARMOR PLATING

The following tabulation indicates the Weight and C.G. of items added and/or eliminated from the Report, Weight Empty - (50% fuel protection and 100% armor plating) for:

(a) 50% vs 100% fuel protection

(b) No fuel protection nor armor plating vs 50% fuel protection and armor plating.

| | Weight | Horizontal | |
|---|---|---|---|
| | | Arm | Moment |
| (a) 100% vs 50% Fuel Protection Self-Sealing Fuel Cell Items, Etc. | | | |
| Added One Side | | | |
| Fuel Cells (5) | + 533.0 | 269 | + 143,377 |
| Interconnecting Tubing | + 25.0 | 269 | + 6,725 |
| Vents and Guards | + 5.0 | 269 | + 1,345 |
| Fuel Cell Liners, Wooden Backing Plates and Canvas Curtains | + 90.0 | 269 | + 24,210 |
| Dump Valve Hole Cover | + 0.5 | 265 | + 133 |
| | + (653.5) | (269) | + (175,790) |
| Items Removed One Side | | | |
| Purging System (9-1/2#) | - 27.2 | 314 | - 8,541 |
| Dump Valve & Control | - 6.0 | 265 | - 1,590 |
| Dump Valve Duct | - 13.0 | 330 | - 4,290 |
| | - ( 46.2) | (312.1) | - ( 14,421) |
| (a) Total . . . . . . . . . . . . . . | + (607.3) | (265.7) | + (161,369) |

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(b) No Fuel Protection or Armor Plating vs 50% Fuel Protection and Armor Plating.

| | Weight | Horizontal | |
|---|---|---|---|
| | | Arm | Moment |
| Items Eliminated | | | |
| Self-Sealing Fuel Installation - Fuel Cells (5) | - 533.0 | 269 | - 143,377 |
| Interconnecting Tubing | - 25.0 | 269 | - 6,725 |
| Vents and Guards | - 5.0 | 269 | - 1,345 |
| Fuel Cell Liners, Wooden Backing Plates and Canvas Curtains | - 90.0 | 269 | - 24,210 |
| | - (653.0) | (269) | - (175,657) |
| Items Removed One Side | | | |
| Purging System (9-1/2#) | - 27.2 | 314 | - 8,541 |
| Dump Valve and Control | - 6.0 | 265 | - 1,590 |
| Dump Valve Duct | - 13.0 | 330 | - 4,290 |
| | - ( 46.2) | (312.1) | - ( 14,421) |
| * Armor Plating Installation Less | + ( 0.5) | (265 ) | - ( 133) |
| Attaching Parts-Removed | | | |
| ** Armor Plating @ Tunnel Gun | - 118.9 | 539 | - 64,087 |
| ** Armor Plating @ Waist Gun Turret | - 94.2 | 426 | - 40,129 |
| Armor Plating for Fuel Protection | - 105.0 | 285.8 | - 30,009 |
| Armor Plating @ Pilots' Seats | - 180.0 | 116 | - 20,880 |
| ** Armor Plating @ Bow Gun | - 53.9 | 22 | - 1,186 |
| | - (552.0) | (283.1) | - (156,291) |
| Items Added One Side | | | |
| Dump Valve Hole Cover | + ( 0.5) | (265) | + ( 133) |
| (b) Total . . . . . . . . . . | - (1250.7) | (276.8) | - (346,236) |

* Provision for armor plating is not readily removable, therefore, it is not removed for the above condition.

** Indicates actual weight of armor plate; other armor plate weights are calculated.

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## B. WEIGHT and BALANCE SUMMARY

(Ref. Report ZW-28-060, Actual Weight and Balance)

|  | Weight | Functional Crew ** |  | Battle Crew *** |  |
|---|---|---|---|---|---|
|  |  | CG Aft Horiz. Ref. Line | % MAC | CG Aft Horiz. Ref. Line | % MAC |
| Gross Weights |  |  |  |  |  |
| 785 Gal. Patrol | 28,723 | 250.2 | 27.7 | 252.8 | 29.3 |
| * 1463 Gal. Patrol | 33,106 | 251.3 | 28.4 | 253.6 | 29.8 |
| 500 Gal.Bomber (2) 1000# Bombs | 29,041 | 249.0 | 27.0 | 251.6 | 28.6 |
| 500 Gal.Bomber (4) 1000# Bombs | 31,041 | 249.0 | 27.0 | 251.4 | 28.4 |
| 500 Gal.Bomber (12) 100# Class (116#) Bombs | 28,562 | 249.8 | 27.5 | 252.4 | 29.0 |
| 1000 Gal.Bomber (2) 1000# Bombs | 32,228 | 250.4 | 27.8 | 252.7 | 29.2 |
| 500 Gal.Torpedo (2) Mk. XIII Torpedo | 31,095 | 249.0 | 27.0 | 251.4 | 28.4 |
| 500 Gal.Bomber (2) 1000# Bombs Less Bombs, Ammunition & Fuel | 23,453 | 243.9 | 23.9 | 266.3 | 37.4 |
| 785 Gal.Patrol including smoke tank installation (not a normal load) | 29,765 | 250.1 | 27.6 | 252.6 | 29.2 |
| Most Forward Flying C.G. | 23,821 |  |  | 242.9 | 23.3 |
| Most Aft Flying C.G. | 33,026 |  |  | 254.1 | 30.1 |
| Weight Empty | 19,882 | 246.0" Aft Ref. Line = 25.2% M.A.C. |  |  |  |

* 1478 gals. of fuel represents capacity of Goodyear self-sealing fuel cell in one side of wing (603 gals.) plus capacity of integral fuel tank in the other side of the wing (875 gals.).

### ** Crew Functional

Pilot
Co-Pilot
Navigator
Radio Operator
Mechanic
Bunk Station #5 - #6 (2)

### *** Crew Battle

Bomber
Pilot
Radio Operator
Mechanic
Waist Gunners (2)
Tunnel Gunner

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## C. Armament (Ref. C.A.C. Dwg. 28F1001)

### 1. Flexible Guns

#### a. General

There is one caliber .30 flexible Browning aircraft machine gun (Model M-2) installed in the bow and one at the tunnel position. There is one caliber .50 flexible machine gun of same model installed in both port and starboard side blister positions.

#### b. Bow Gun (Ref. C.A.C. Dwg. 28F1001)

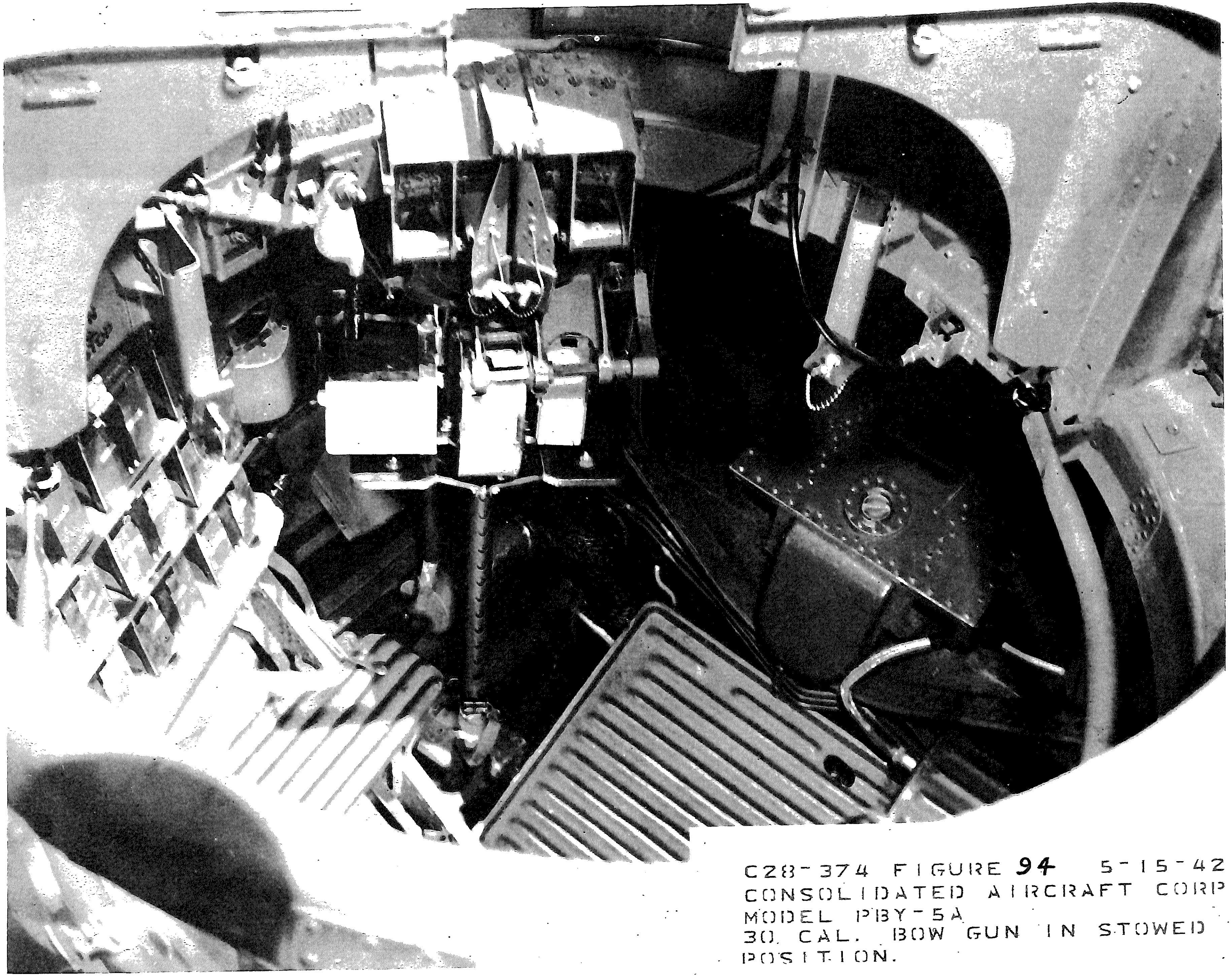
#### (1) Description

A .30 caliber flexible Browning aircraft machine gun (Model M-2) with Mk. IX adaptor is installed in the bow cockpit. The Mk. IX adaptor seats in a post socket stirrup. This carriage, together with the revolving circular windshield, moves on a track which is permanently fastened to the structure of the hull.

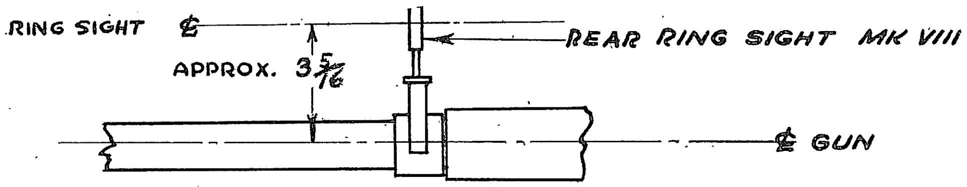
The stirrup which supports the conventional post socket is locked in the firing position by means of the lever on the right hand side. This lever operates through a torque shaft and toggle follower. This follower locks against a sled which is positioned by two headless screws protruding through the top projection of the housing. The desired pressure is obtained by setting the sled through these screws, which are locked by locknuts. The motion of the toggle beyond dead center is regulated by the two round head screws on top of the stirrup. The cut-out or slot in the turret is designed to permit 5°, either way, relative train of the gun in a horizontal plane. See Part (4), of this section for this adjustment.

The carriage (riveted to windshield) moves on the circular track by means of 17 rollers, 4 large rollers moving about a horizontal axis; 13 about a vertical axis. The revolving windshield moves on 7 vertical and 8 horizontal rollers. To make windshield and mount readily removable all horizontal rollers and the lower lower vertical roller bracket on the carriage can be removed. The mount and windshield move together on the track. A friction lock to the left of gun is provided for use when exchanging ammunition magazines. The gun can be trained horizontally 5° either way relative to the windshield and from vertical up, to 40° down. For turning the gun and windshield when firing up, a bail with adjustable hip clamps has been provided. The fixed backrest, which is built on the windshield assembly above the movable bail, is to be used for horizontal fire.

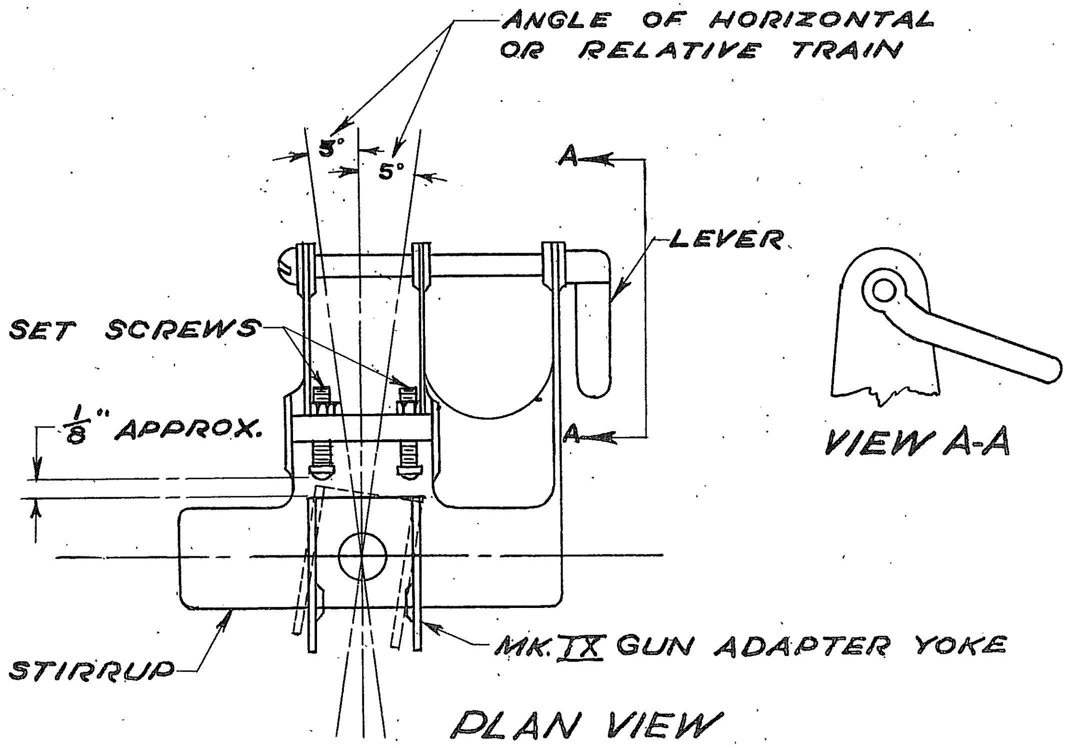
A friction type drag lock is provided which retards rotation of the turret while firing the gun. This lock mounted on the gun body consists of a spring loaded friction block which exerts a constant pressure against the circular track. A trigger assembly mounted on the right hand side of the gun is connected to the locking mechanism by a cable (28F6312) which runs through



C28-374 FIGURE 94 5-15-42
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A
30. CAL. BOW GUN IN STOWED
POSITION.



(B) INSTALLATION OF RING SIGHT



(A) ADJUSTMENT OF ANGLE OF TRAIN

FIGURE 95
BOW GUN ADJUSTMENT

a length of bowdenite casing. Operation of the trigger releases the pressure of the friction blocks against the circular track. The drag lock action is continuous until released by the trigger. The gun turret may be readily removed when the trigger is used. (Ref. C.A.C. Drawing 28F6311) When not in use on the gun, the trigger assembly is mounted on the starboard side of the turret bulkhead (Ref. C.A.C. Drawing 28B1307) and from this position the trigger may be released to permit movement of the mount and windshield.

### (2) Servicing

The track and mount should be cleaned frequently and the moving parts of the mount lock mechanism lubricated with medium engine oil as required. Care should be taken to prevent oil or grease from remaining on the track or friction lock to maintain the best operation.

### (3) Stowage (See Figure 94, & C.A.C. Dwg. 28F4006)

The following is the recommended procedure:

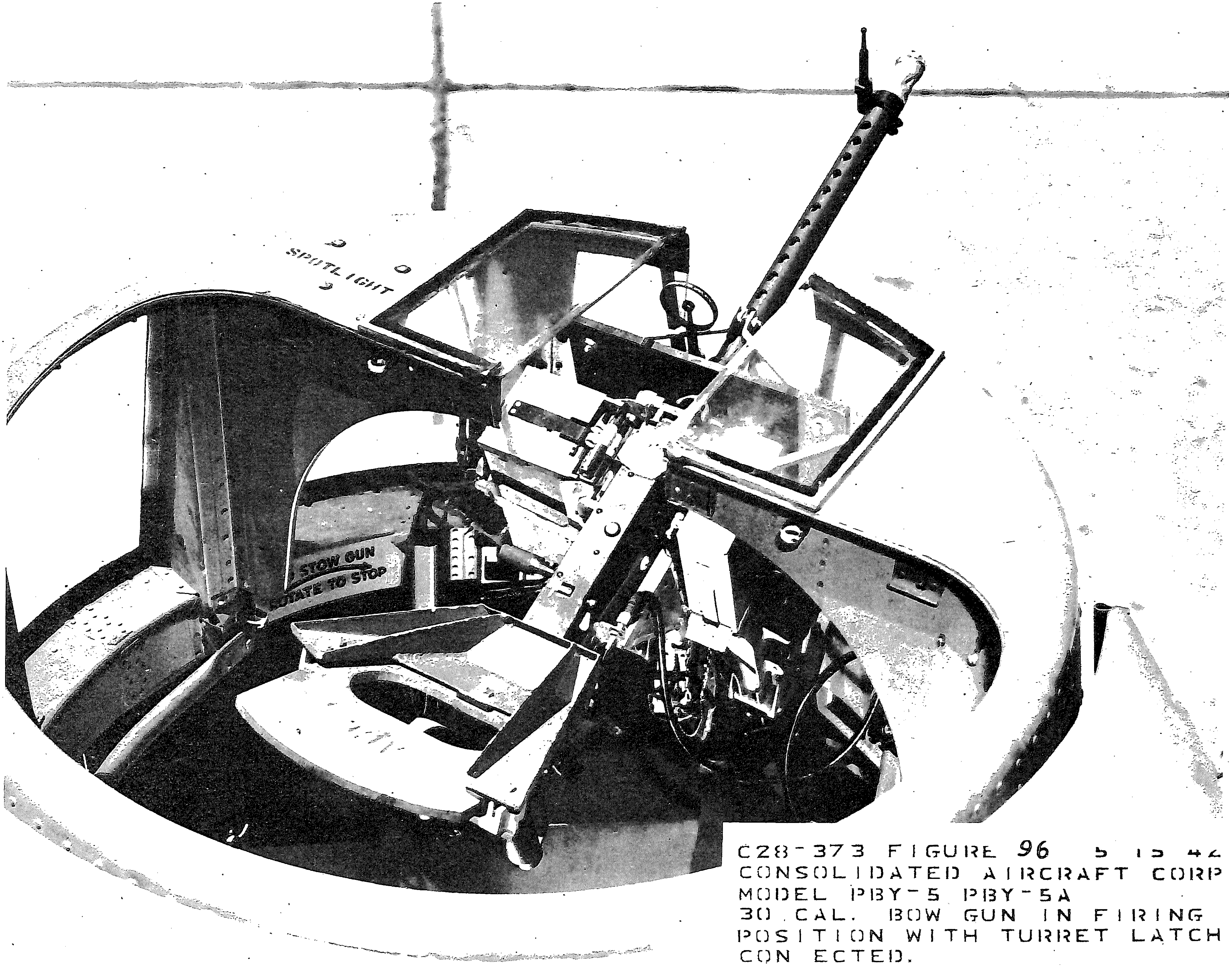
(a) Elevate the gun to its vertical position.
(b) Rotate the windshield clockwise to starboard until it hits the stop.
(c) Hold tight against the stop and lock with friction lock (left of the mount).
(d) Retract the gun by unlocking the stirrup and swing the gun inboard.
(e) Insert the muzzle into the socket aft of the firing step and lock the spade-grip to a bracket on bulkhead #1. (Ref. Figure ).
(f) Slide the slot cover in place.
(g) Insert the harness snaps on the manhole cover (semi-circular) into the eyebolts on the windshield on the straight side of the manhole.
(h) Swing the cover up and lock with the toggle locks along the rim.

To bring the gun into firing position, reverse the above procedure.

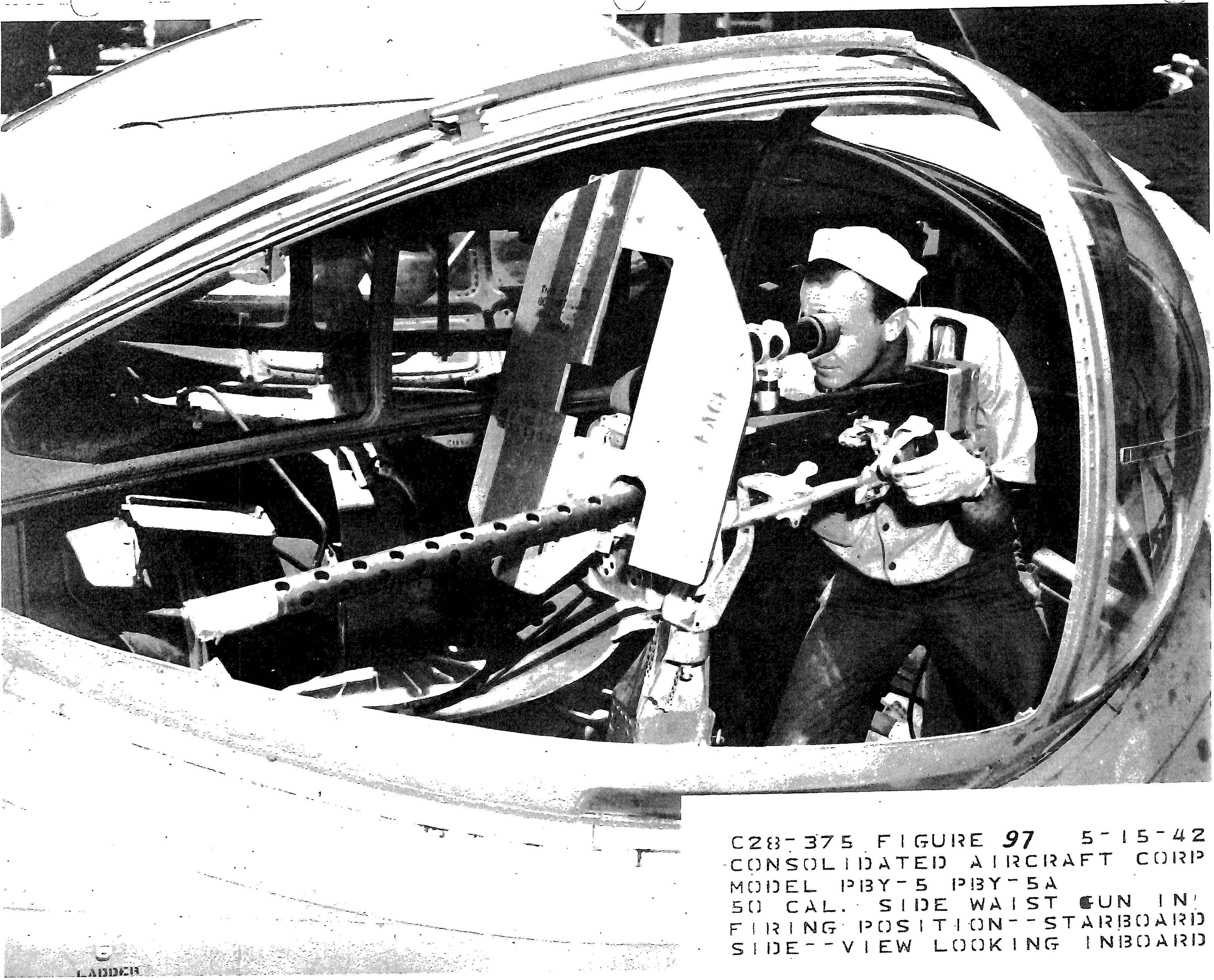
Nine Mk. I magazines are stowed in the ammunition magazine racks at the starboard firing step. The feed chute of the Mk. I magazines is to point outboard. One Mk. I magazine is to be placed into the holder on the Mk. IX gun adaptor.

### (4) Adjustment of Horizontal Train

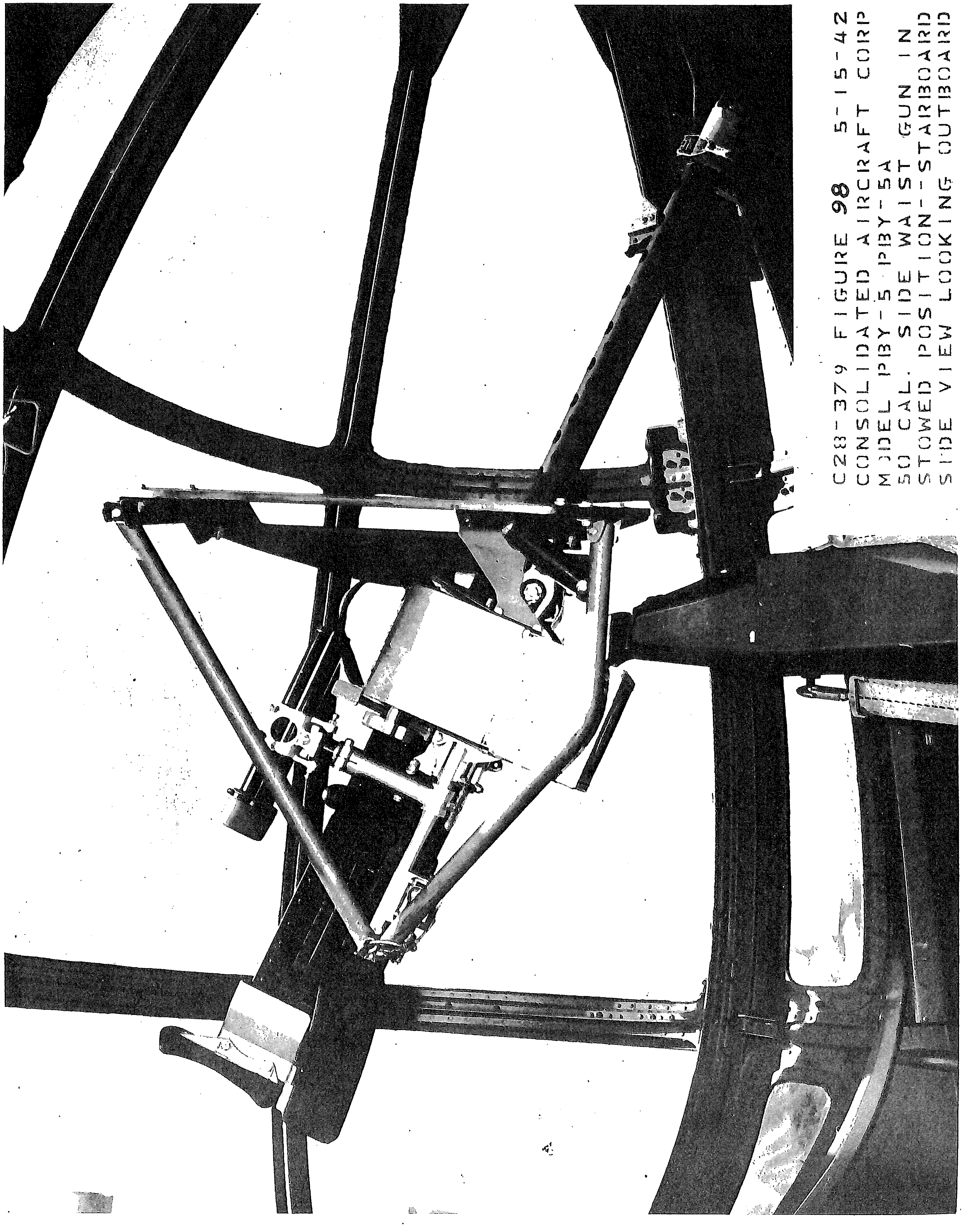
The plus or minus 5° relative angle of horizontal train is obtained by adjusting the two set screws mounted in the upper link shaft of the toggle lock. For this angle the distance between the head of the screws and the lower edge of the Mark 3 gun adapter yoke is approximately one-eighth inch with gun in center position. See (A), Figure 95.



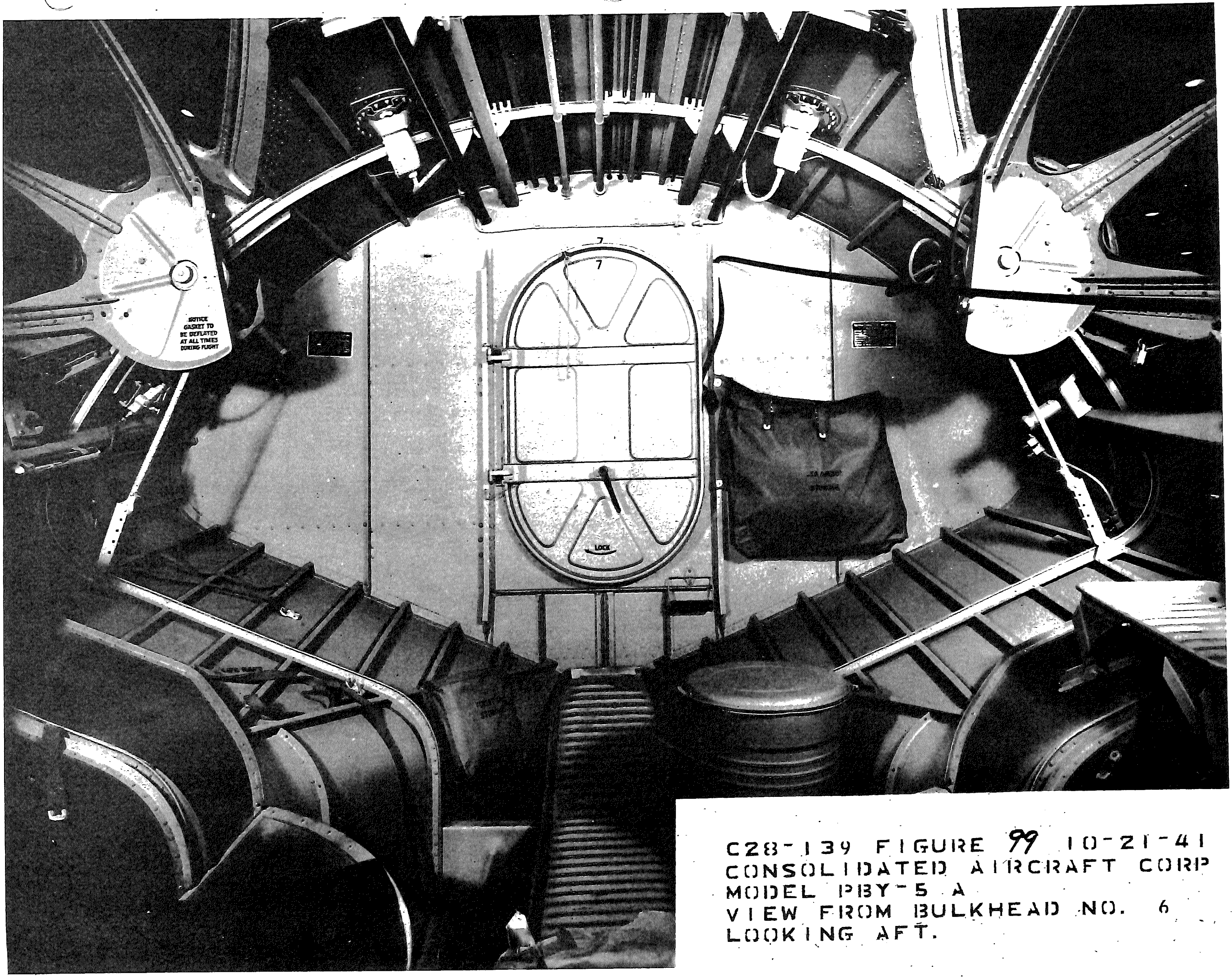
C28-373 FIGURE 96 5 15 42
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5 PBY-5A
30 CAL. BOW GUN IN FIRING POSITION WITH TURRET LATCH CON ECTED.



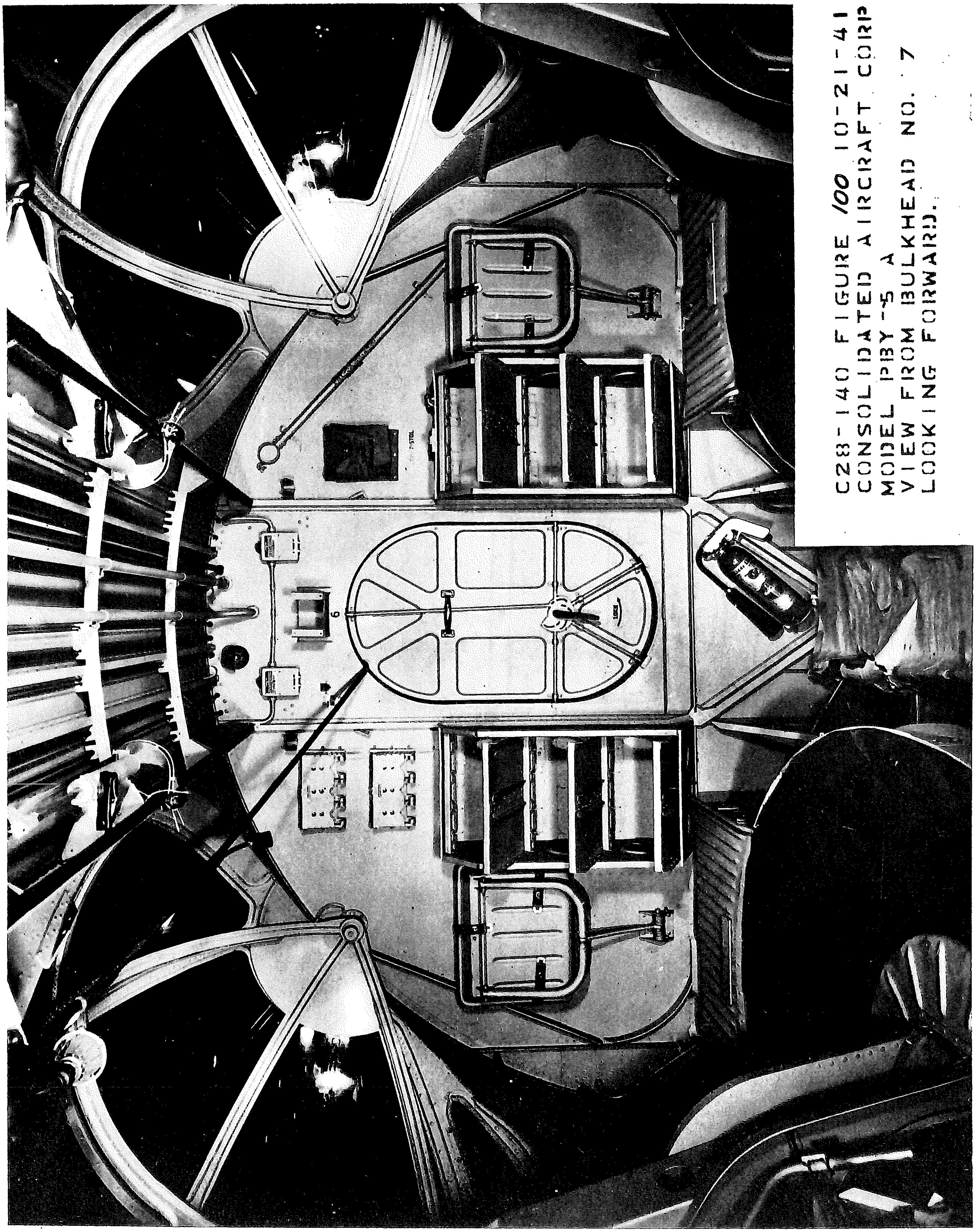
C28-375 FIGURE *97* 5-15-42
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5 PBY-5A
50 CAL. SIDE WAIST GUN IN
FIRING POSITION--STARBOARD
SIDE--VIEW LOOKING INBOARD



C28-379 FIGURE 98 5-15-42
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5 PBY-5A
50 CAL. SIDE WAIST GUN IN
STOWED POSITION--STARBOARD
SIDE VIEW LOOKING OUTBOARD



C28-139 FIGURE 99 10-21-41
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5 A
VIEW FROM BULKHEAD NO. 6
LOOKING AFT.



C28-140 FIGURE 100 10-21-41
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5 A
VIEW FROM BULKHEAD NO. 7
LOOKING FORWARD.

The necessary pressure applied to the lower tip of the lever when locking the stirrup to the carriage should not have to exceed 17 pounds.

(5) Installation

In order to assure definite clearance between ring sight (rear ring sight - Mark 8) and edges of gun slot in revolving circular windshield, the ring sight should be installed according to dimensions given in (B), Figure 95.

c. Side Waist Guns (Ref. C.A.C. Dwg. 28A4006)

(1) Description

Two caliber .50 flexible B.A.M. guns, Model M-2 with Mk. X left hand side firing attachment for port gun and Mk. X-1 right hand side firing attachment for starboard gun.(B.O. 298626) are provided for in the midship teardrop turrets. The gun adaptor yoke seats in a stationary post socket which is mounted in a cantilever post riveted to the structure of the airplane.

The Aircraft Telescope Sight, Mark 5-1, #B.O. 233200 is intended for the above mentioned gun adaptor. There is provision for seven ammunition magazines Mark 5 (Bell Aircraft #GM-749-294) six in racks on bulkhead #6 and one on the gun.

A firing guard is provided in each tear drop turret, the purpose of which is to prevent the guns being fired into the rear of the hull. It consists of a metal rod attached to the hull just below the tear drop turret. When the rotating part of the turret is raised for the purpose of permitting the firing of the gun, the firing guard is lifted and attached to the clamp provided on the revolving portion of the turret. Before the turret is closed the firing guard is replaced in its stowed position.

For view of the waist gun in the firing position, see Figure 97.

(2) Stowage (Ref. Figure 98)

The gun is to be stowed on the mount in a fore and aft position. The muzzle rests in a cradle and is to be secured with the metal strap provided with a trunk fastener.

To stow the gun, follow the procedure given below:

(a) Swing the gun inside the ship with the muzzle pointing aft.

(b) Close and lock rotating shield of gun turret. Refer to Section IV, Part A-A.

(c) Secure with the metal strap attached to the hull just above and aft of the gunner's step.

(d) Secure the rear of the gun to the anchor located aft of bulkhead #6 with the strap provided.

d. Tunnel Gun (Ref. C.A.C. Dwg. 28A1004)

(1) Description

A caliber .30 flexible Browning aircraft machine gun with Mark 9 adaptor is installed in a stirrup at the forward part of the tunnel opening in the bottom of the hull. The gun is equipped with a Mark VIII ring sight and a Mark V post sight.

The ammunition rack for 500 rounds of ammunition is located on the starboard side and holds four Mark I magazines. Mark 3-1 ejected case containers and Mark 5 ejected link container are stowed adjacent to the ammunition rack.

The stirrup hinges in a V-brace which in turn hinges about an axis on the port side on the bottom of the hull approximately parallel to the skin.

(2) Operation

To bring gun into firing position: Unlatch the tunnel door then swing up into vertical position about the hinge aft of the opening and fasten door on top with catch provided. Next, unlatch the spade grip and reverse the stowing procedure. (See Figure 102).

Use strap to hold the mount in the stowed position when the gun is not carried.
For view of the firing position, See Figure 101 .

(3) Stowage

The procedure for stowing the tunnel gun is outlined below.

(a) Unscrew locking bolt.

(b) Swing the stirrup into vertical position.

(c) Fasten the stirrup to V-brace by toggle lock.

(d) Swing the gun and stirrup about the V-brace hinge into stowage position at the port side of the hull.

(e) Place the barrel in stowage hook and latch the spade grip in place as shown in Figure 102.

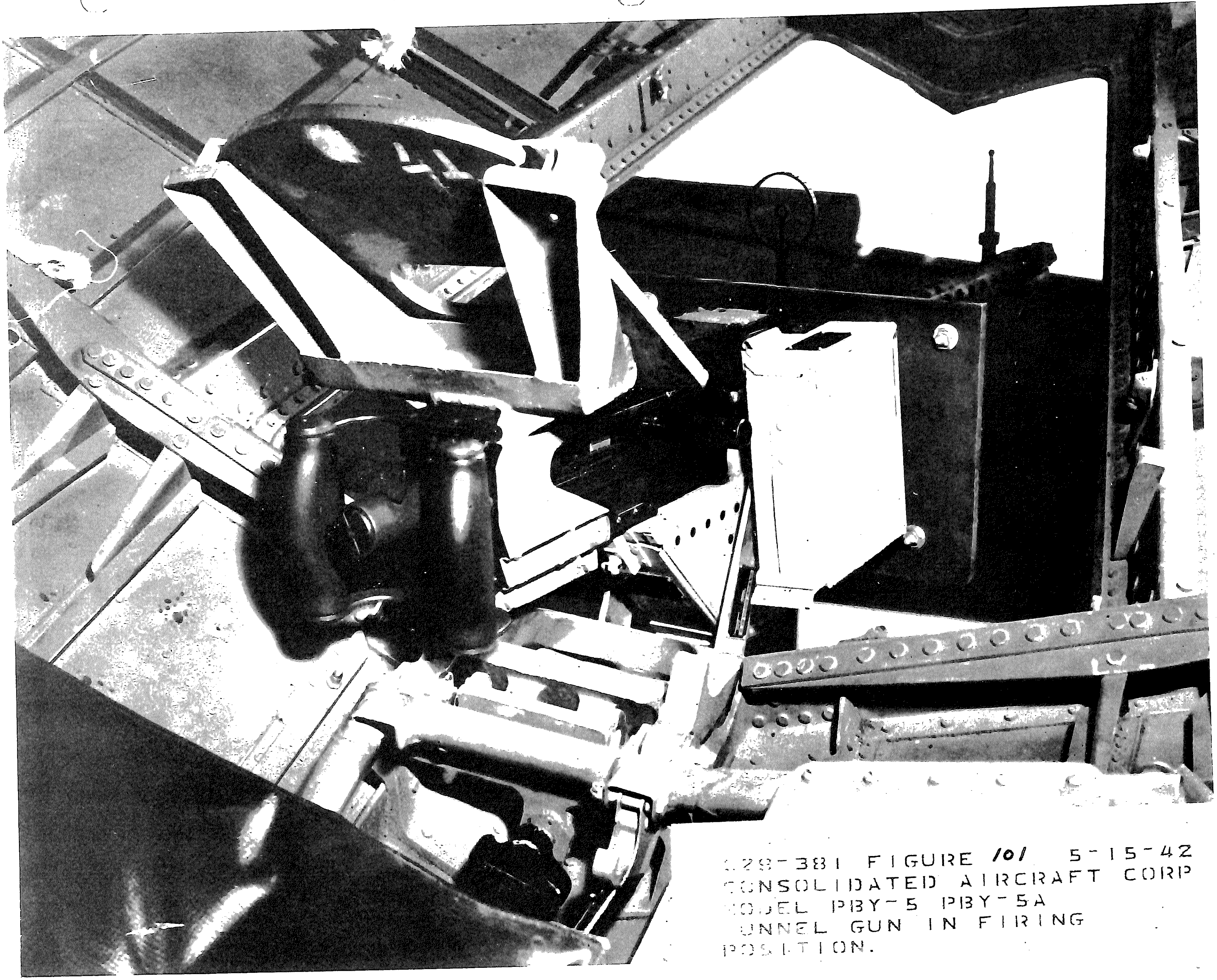
2. Bombing Equipment (Ref. C.A.C. Dwg. 28A2010)

a. General Description

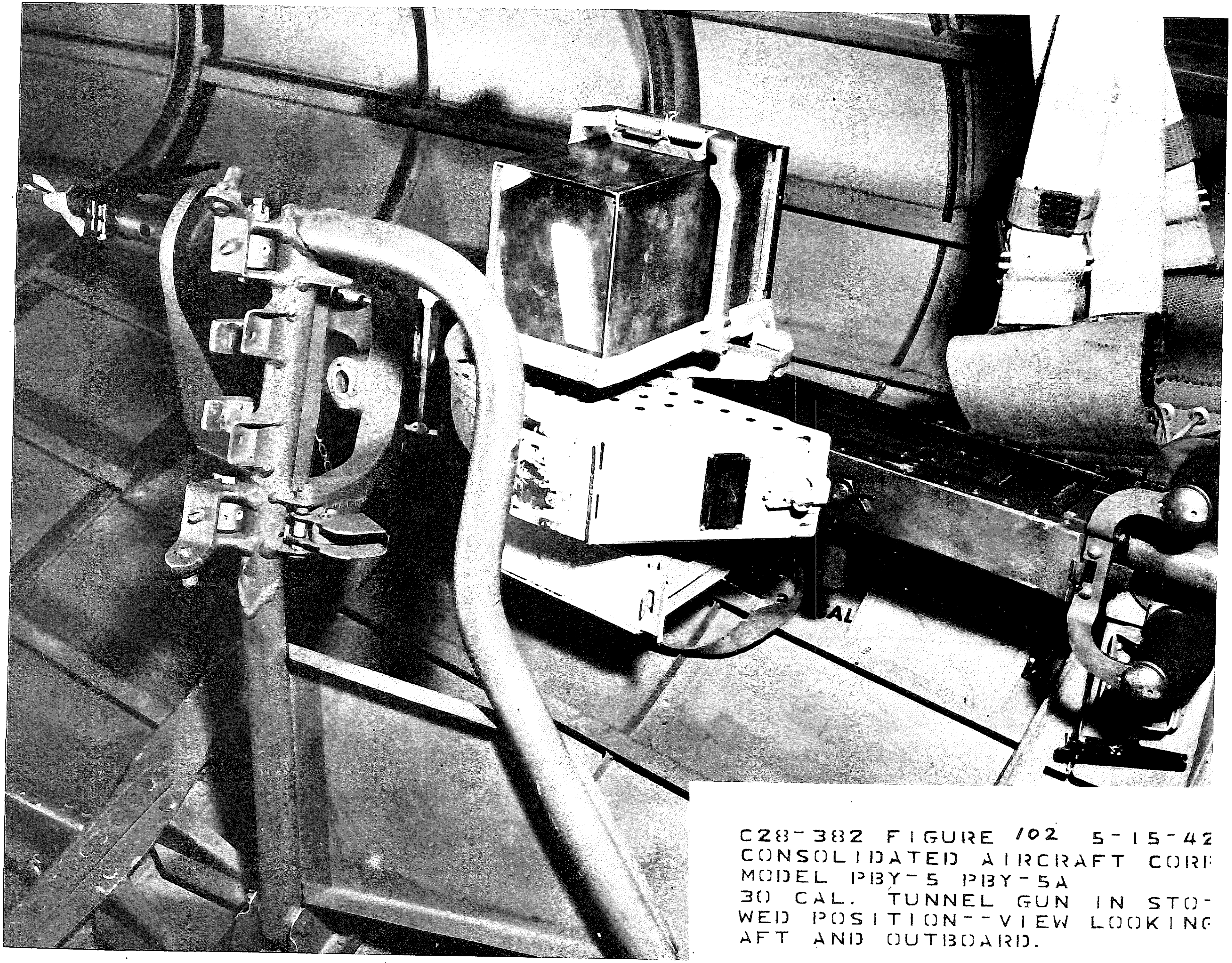
(1) Bomb Loads (Ref. Figures 103,4,5)

The following combinations of bombs and torpedoes may be carried on the racks installed on the wings:

2 or 4 - 1000 pound demolition bombs
4 - 500 pound demolition bombs
12 - 100 pound demolition bombs
2 - 1935 pound torpedoes, Mark XIII-1



28-381 FIGURE 101 5-15-42
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5 PBY-5A
TUNNEL GUN IN FIRING
POSITION.



C28-382 FIGURE 102 5-15-42
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5 PBY-5A
30 CAL. TUNNEL GUN IN STOWED POSITION--VIEW LOOKING
AFT AND OUTBOARD.

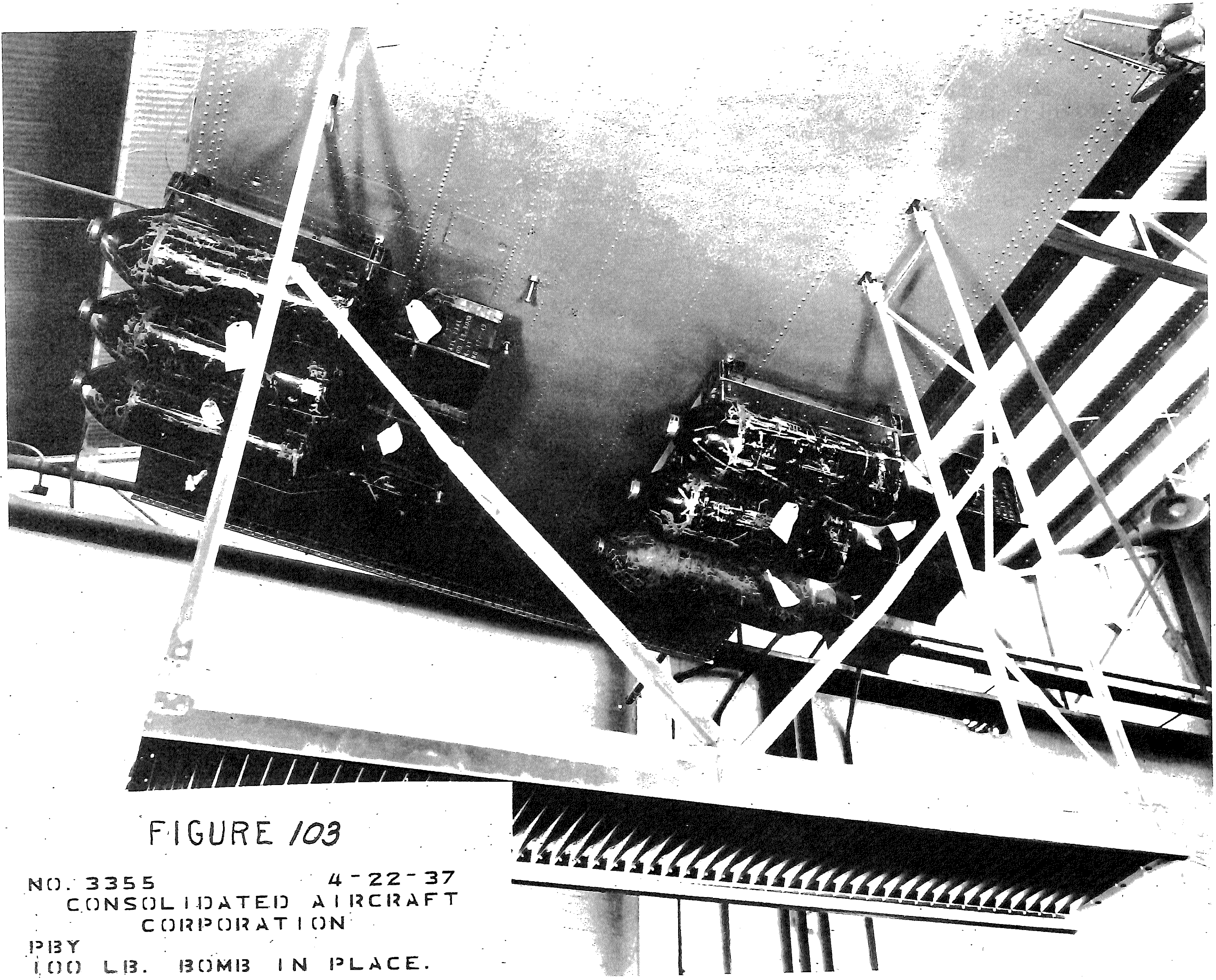


FIGURE 103

NO. 3355 4-22-37
CONSOLIDATED AIRCRAFT
CORPORATION
PBY
100 LB. BOMB IN PLACE.

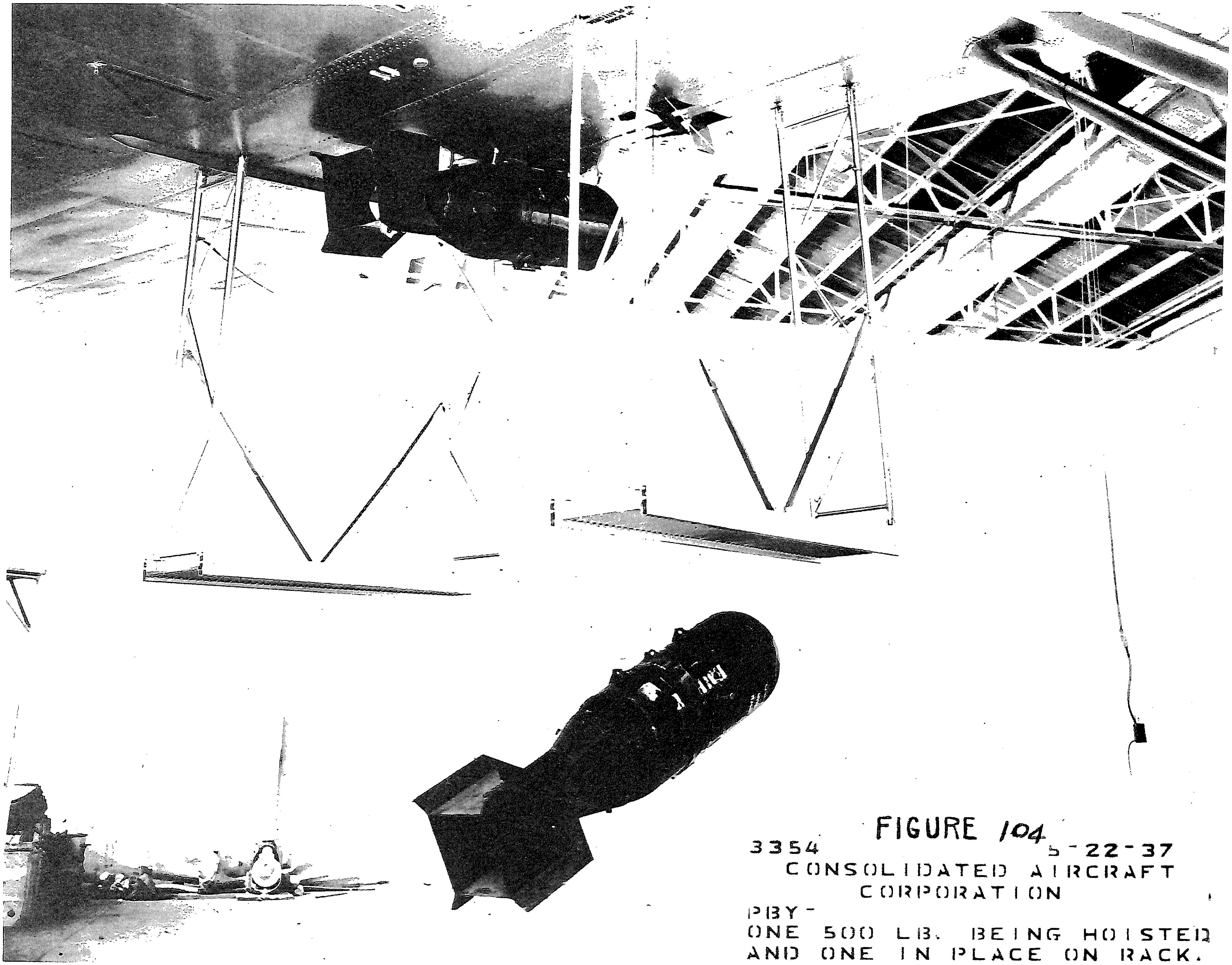


FIGURE 104

3354 5-22-37

CONSOLIDATED AIRCRAFT
CORPORATION

PBY-
ONE 500 LB. BEING HOISTED
AND ONE IN PLACE ON RACK.

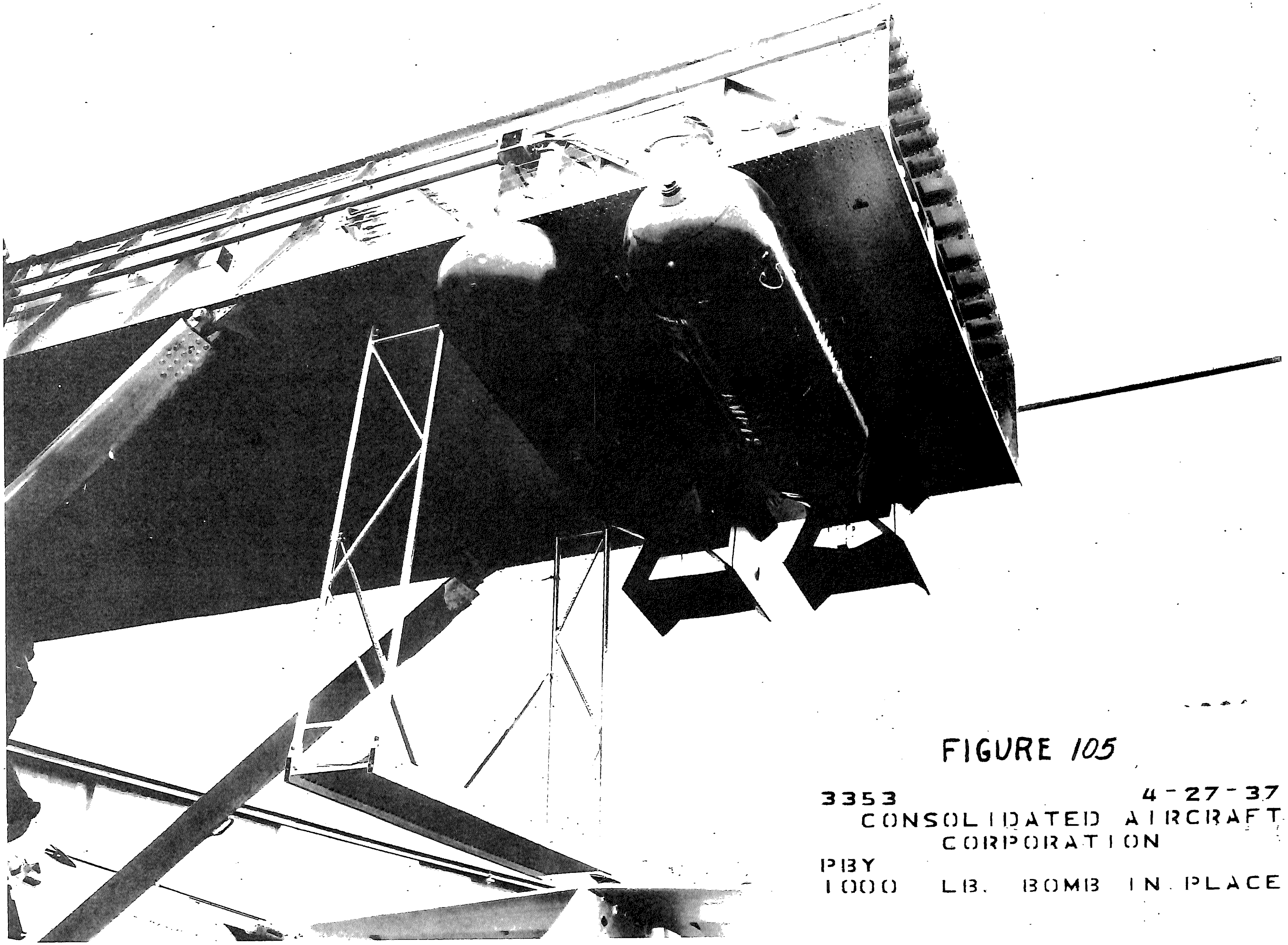


FIGURE 105

3353 4-27-37
CONSOLIDATED AIRCRAFT
CORPORATION
PBY
1000 LB. BOMB IN PLACE

Fuel and oil loads to correspond with the above combinations are described in Parts A and B of Section V.

(2) Racks (Ref. C.A.C. Drawing 28A2010)

The service bomb rack arrangement consists of four Mark XXXV-6 bomb racks. The above model racks are mounted inside the center section of the wing near the lower skin surface. They are placed two on each side of the airplane, outboard of the nacelles. The racks are placed side by side in such a manner as to accommodate any of the following bombs: - 100# bomb (except the Mark I, Model III) (Figure 103), 500# bomb (Figure 104), 1000# bomb, 500# water filled practice bomb and 100# water filled practice bomb.

Access to the Mark XXXV-6 bomb racks is through openings on the bottom of the wing as shown on Figure 13.

The forward and rear holes are for the welded supporting lugs on the bombs to enter the wing and hook on to the bomb rack hooks. The hole in between is for the hoist cable to raise the bomb and to provide access for removing the pin which attaches the bomb hoist cable to the hoisting lug welded to the bomb. There are two hinged access doors just inboard of the outboard racks and two hinged access doors just inboard of the inboard racks. These doors are for access to the Mark XXXV-6 racks by personnel standing on the loading platforms (C.A.C. Drawing 28A1063). Through these doors it is possible to operate the release mechanism and the slide bar and rotate the bomb hooks into the unlocked position ready for hooking on a bomb. Rigging the hoisting cable through the racks is also done through these access doors.

There are six adjustable chocks for each rack; two castings at the rear chock the rear end of all bombs; two castings at the extreme front chock the front end of the 500# and 1000# bombs; and two nut plates near the front are for chocking the front end of the 100# bomb only.

The 100# water filled bomb has a sheet metal fin near its rear end and extending upward in such a manner that it cannot be suspended from the Mark XXXV-6 rack without interference. It is recommended that this fin either be removed or bent down out of the way when the bomb is to be carried.

In addition to the Mark XXXV-6 racks, provision is made for the alternate installation of four Mark XLII practice racks. These racks are suspended externally beneath the wing, two in tandem on each side of the center section. Three 100# bombs per rack, or twelve in all, may be carried on the Mark XLII racks which are shown installed on Figure 110.

Provision is made for attaching two Mark XIII-1 torpedo racks (C.A.C. Drawing 28A5001) for carrying two 1935# torpedoes, one on each side, just outboard of the wing struts. Figure shows this installation.

### (3) Bomber's Compartment (Figure 106)

The bomber's compartment is located forward of the pilot's compartment in the nose of the airplane.

Provision has been made for the installation of a Mark 15-5 bombsight in the bomber's compartment. The sight is rubber mounted and located directly in front of the bomber's seat.

The bomber's seat is adjustable with a removable back rest.

The bomber's sighting window is provided with two metal covers. The outboard cover is retractable and retracts up into the nose upon operation of the retracting mechanism located in the bomber's compartment at the top of the window.

The inboard window cover is replaced by a cover with a quick release locking arrangement. It is held down by eight locks, (Ref. C.A.C. Drawing 28B5186-7) which can be released simultaneously by operating the locking mechanism in the center of the cover. Either type of inboard cover can be removed with the bombsight in place.

A hand hole, with a cover removable on the inside, is located just to the right of the sighting window in the nose of the airplane. The hand hole permits the bomber to clean the outside of the window during flight. For the position of this access opening see Figure

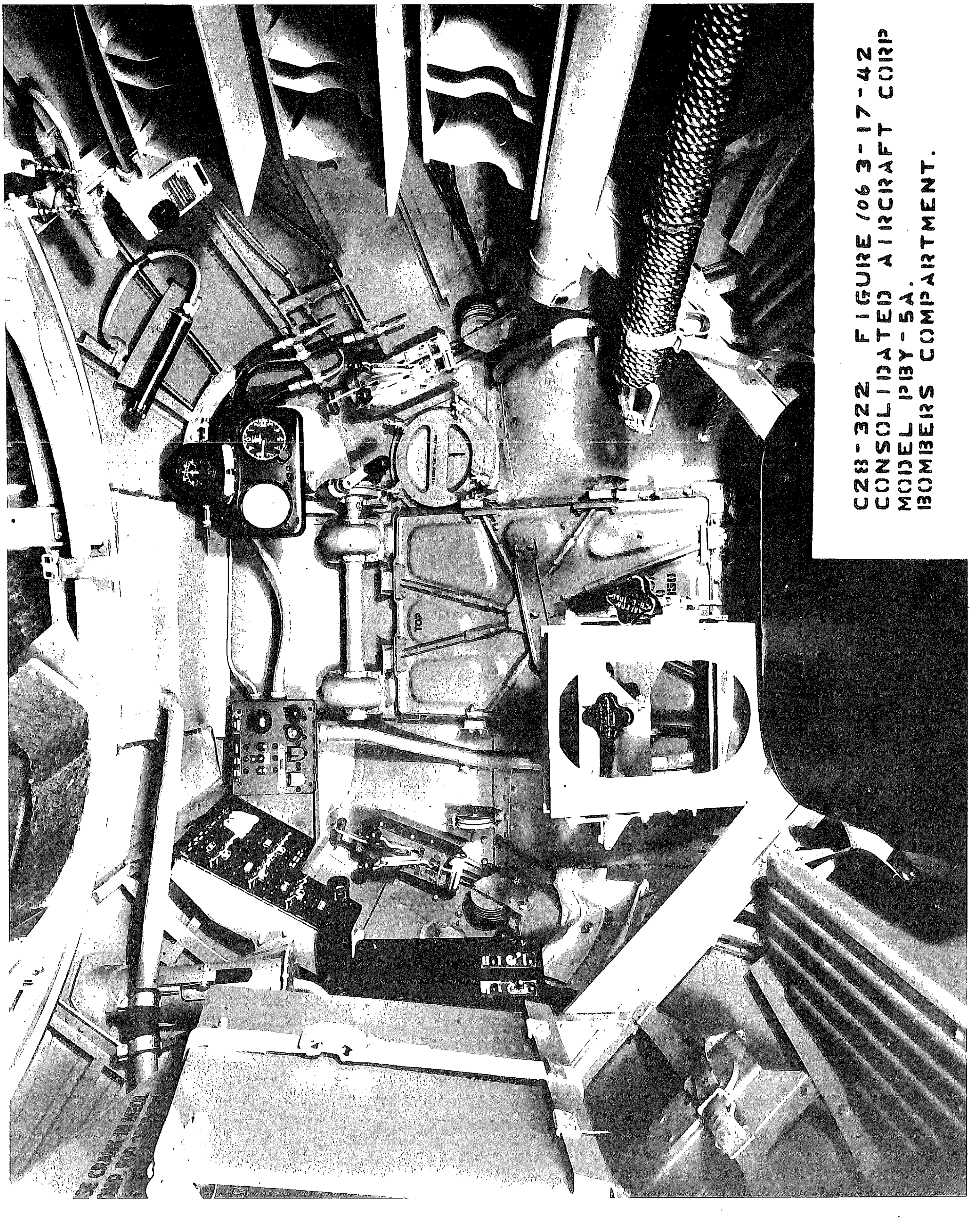
There are two control panels on the port side of the hull in the nose equipped with electrical selector and release switches. The instrument panel is on the starboard side of the sighting window as shown by Figure . For a tabulation of the bomber's instruments see Section IV, Part "H".

### (4) Controls (Figures 48 & 106)

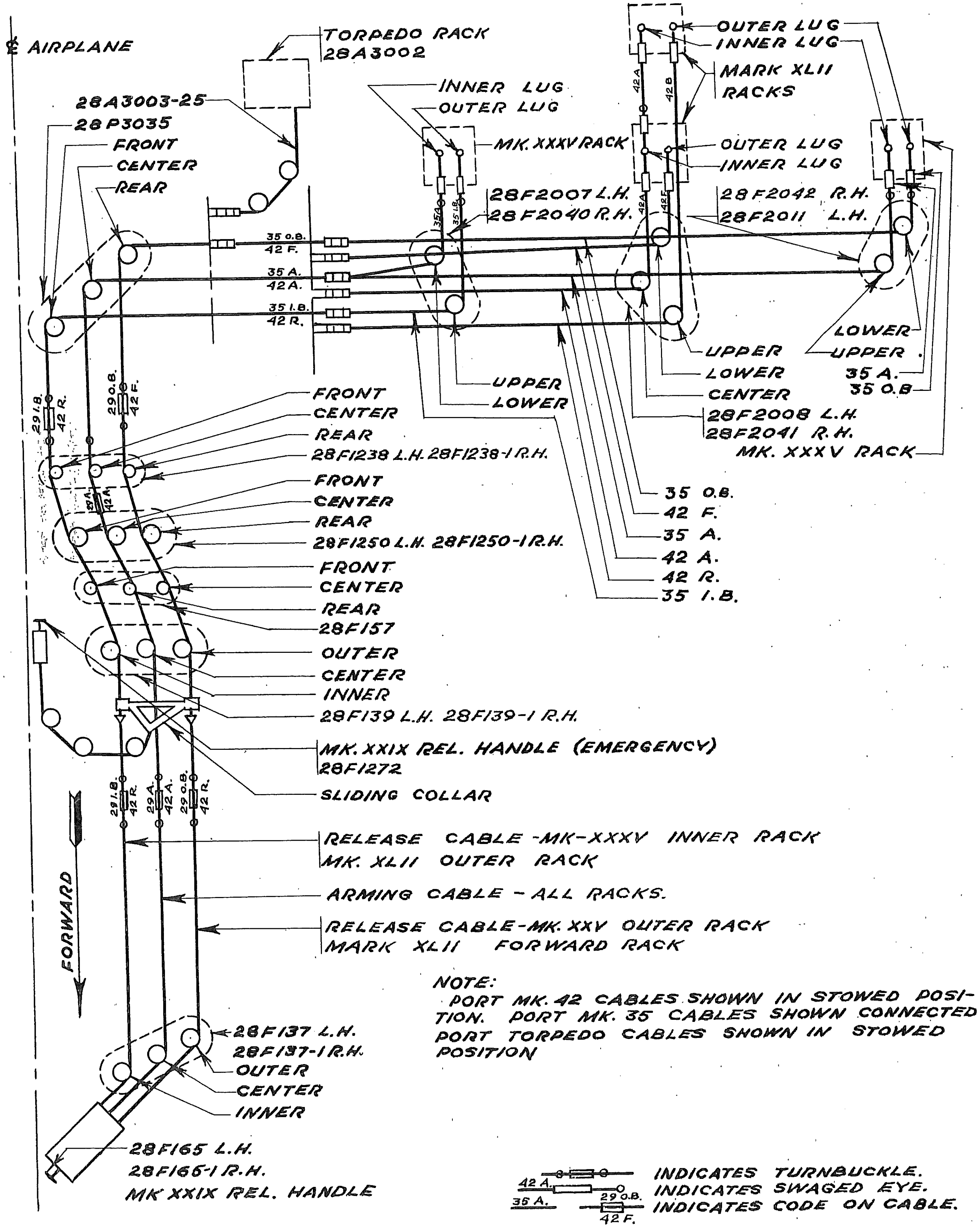
#### (a) General

The bomber's electric control panel is located on the port side of the bomber's compartment. The firing key, Type NAF Std. 1174, is stowed in a canvas bag on the port side below the panel. The bomber's manual release and arming controls are located on each side of the sighting window. Each set of controls is connected to the bomb racks on its respective side of the airplane.

Bombs may be released both electrically and manually. The Mark XLII racks may be armed both electrically and manually, but the Mark XXXV-6 racks can be armed manually only.



C28-322 FIGURE 106 3-17-42
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A.
BOMBERS COMPARTMENT.



NOTE:
PORT MK. 42 CABLES SHOWN IN STOWED POSITION. PORT MK. 35 CABLES SHOWN CONNECTED PORT TORPEDO CABLES SHOWN IN STOWED POSITION

REFER TO C.A.C. DWG'S.
28F3064 & 28A1015

FIGURE 107
TORPEDO & BOMB RELEASE CABLE CHART

The emergency salvo release controls are located only in the pilot's compartment. They are described in paragraph (d) below.

The emergency salvo release also functions as the pilot's torpedo release control. Each salvo handle controls the torpedo on its respective side of the airplane. The torpedo director is installed in the cockpit where it may be used by either pilot.

### (5) Arm and Release System

#### (a) Electrical

The control switches for electrical arming are on the bomber's switch panel. They control arming of the bombs in the racks by means of electrical solenoids.

Electrical bomb release equipment is provided on the port side of the bomber's compartment. An auxiliary firing station, consisting of a firing key outlet, is provided at the pilot's electrical panel.

The bomber's switch panel provides mounting for 16 switches to operate the Mark XLII racks and 4 switches for the operation of the Mark XXXV-6 racks. Two switches provide for bomb release control either manually by means of the firing key or automatically through the Mark 15-5 bombsight.

Nameplates on the bomber's switch panel identify the bombs controlled by each switch. The lower 12 switches on the left side of the bomber's switch panel are for the Mark XLII rack releases. The four switches in the upper left hand corner of the panel marked "ARM" are for arming the Mark XLII racks.

The release control circuits operate relays in the engine terminal boxes through which current is supplied directly from the batteries to the bomb solenoids.

Mark XXXV-6 release circuits are operated through remote control switches NAF 39967, located in the engine terminal boxes inboard of each nacelle. The solenoid currents for the Mark XXXV-6 racks pass direct from storage batteries through these remote switches in the rack solenoids. The remote switch circuits are operated by the bomber's switch panel equipment.

The switches for electrical torpedo release are located on the starboard end of the pilot's electrical switch panel (Figure 43). An adjacent receptacle provides for the insertion of a firing key to release the torpedo selected. These switches control the torpedo release circuits which operate the relays located on the front spar near the bomb racks which connect the torpedo rack solenoid directly to the battery circuits. There are no torpedo release switches on the bomber's switch panel.

(b) Manual (Ref: Figure 106)

The same release handles, Mark XXIX, are used for both the Mark XXXV-6 and Mark XLII bomb rack manual control. These handles are on either side of the bombsight window, as shown on Figure 106.

In the Mark XLII system, the release handles on the port side of the airplane operate the port racks and those on the starboard side, the starboard racks.

Three release handles and one arming handle are contained on each of the two units. The outboard handle simultaneously releases all the bombs on the forward rack and the inboard handle simultaneously releases all bombs on the rear jack. The upper center handle simultaneously releases all the bombs on both the forward and rear racks.

The lower center handle arms both the front and rear racks. Due to excess spring tension in the arming system, it is necessary to hold the arming handle in the "ARM" position with the lock provided at the control.

All manual bomb control handles are operated by pulling aft.

Manual control is transferred from the release handles to the bomb racks through 3/32 inch diameter flexible control cables shown by Figure 106. The control system for the Mark XLII racks remains in the airplane at all times even when the Mark XLII racks are removed.

There are quick disconnectors along the front spar for switching from the Mark XXXV-6 rack control system to the Mark XLII system and vice versa. The disconnectors of the inactive cables are hooked to the dummies provided. Figure 112 shows the location of these disconnectors in the cable circuit.

The disconnectors are accessible through four marked doors, Figure 13 in the top surface of the wing leading edge. By lying upon the wing, it is possible to reach the cable with both hands and make the necessary changes. The dummy stowages for the idle Mark XLII cables are located on a diagonal wing member forward of the front spar. Dummy stowages for the idle Mark XXXV-6 cables are located directly on the front spar member.

The disconnector controlling one rack is operated by sliding the spring-loaded knurled sleeve outboard until the interlocking hook is sufficiently exposed to permit unhooking. Stowing this cable and reconnecting the corresponding cable for the other rack is done by the reverse process.

The emergency salvo release in the pilot's cockpit serves as the manual release for the torpedoes. Each handle will release the torpedo carried on its respective side of the airplane.

### (c) Emergency Release

Two emergency release handles are located on the pilot's instrument panel. When bombs are carried, a pull on either handle will release all the bombs on its respective side of the airplane in the "SAFE" condition. These releases are cable connected to the racks as shown on Figure 107. The bombs can be dropped in the "SAFE" condition only.

When torpedoes are carried, the salvo release may be used as a manual release control.

> CAUTION: A two inch pull on cables is required to release the bombs. In adjusting the cables, turn the turnbuckles just enough to remove any slack in the cables and no more. Check to see that the release lever is in closed position after the cables have been adjusted. Too great tension on the cables might result in the dropping of bombs inadvertently.

### (6) Torpedo Director

The torpedo director Mark 28-2 (Ref. C.A.C. Drawing 28A5054) is installed on a carriage which runs in two parallel tracks running across the bow of the ship, over the pilot's instrument panel. This arrangement permits the torpedo director to be shifted so that it may be used either by the pilot or co-pilot. Because of the dimensional limitations of the pilot's enclosure, extreme target angles off the port side may be more readily sighted by the co-pilot, and vice versa.

When the torpedo racks are not carried the director may be removed in accordance with instructions contained in part "b" following.

### (7) Instruments and Indicators

Refer to Section IV, Part "H" for data on the bomber's instruments and indicators.

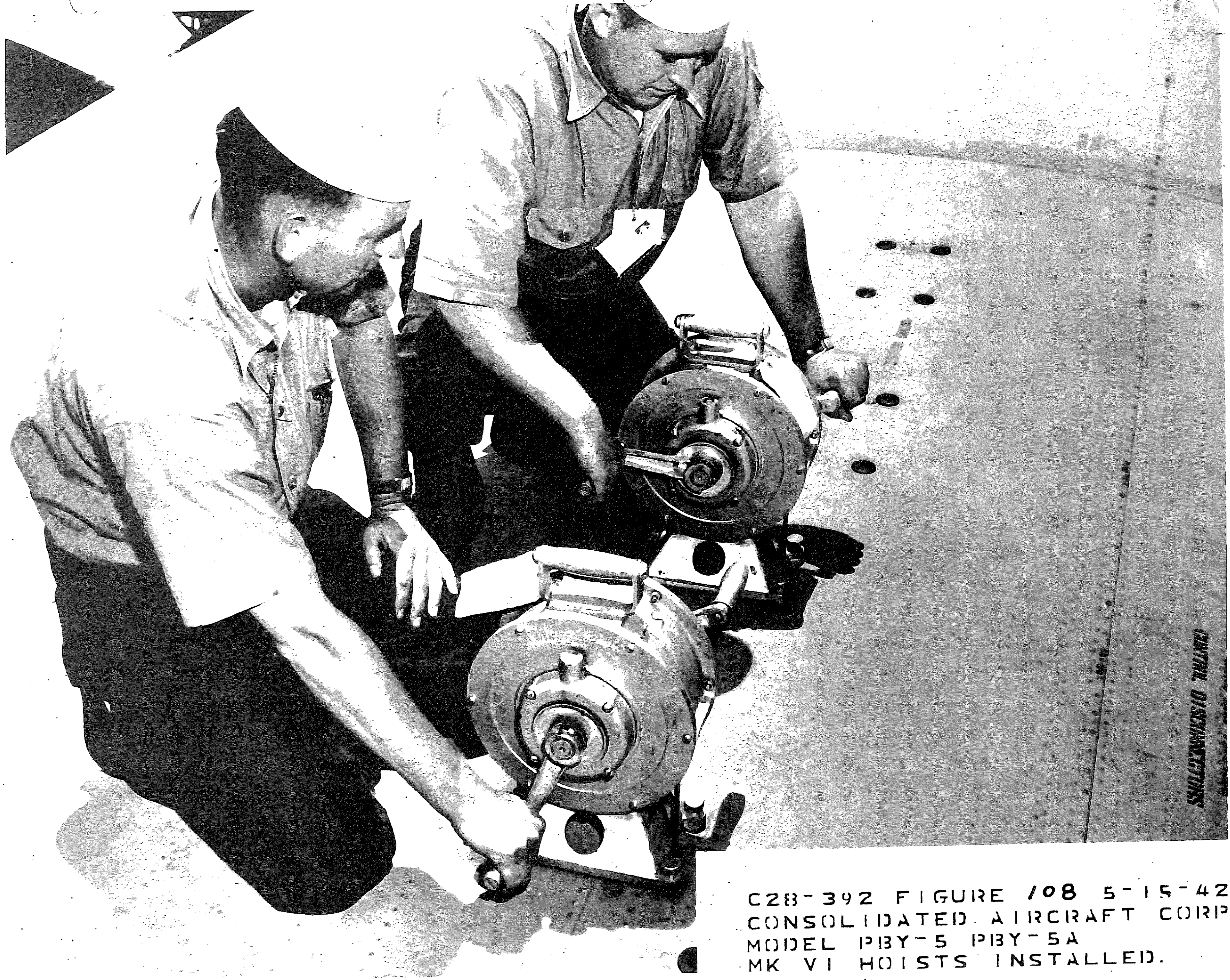
The pilot is provided with a pilot director which is mounted on the starboard side of the pilot's instrument panel. See Figure 47.

### (8) Bomb Hoist (Ref. C.A.C. Drawing 28A2024)

The hoist to be used for both bombs and torpedoes is the Mark 6 Type with the cable shortened in accordance with C.A.C. Drawing 28A2024. The positions of the hoist on the upper surface of the wing are located by the holes for anchorage and cable clearance as shown on Figure 108.

The hoist is anchored by means of four pins, C.A.C. part number 28A2017. If desired, these pins may be secured to the hoist with chains, or other suitable means, to prevent their loss while not in use. See Figure 108 for the installation of the hoist.

Guard tubes are built into the wing from the top surface through to the bomb racks underneath. These serve as guides for the hoist cable which is threaded through the guards for hoisting.



C28-392 FIGURE 108 5-15-42
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5 PBY-5A
MK VI HOISTS INSTALLED.

### (9). Bomb Loading Platform (C.A.C. Drawing 28A1063)

The folding bomb loading platform is furnished to assist in the installation and loading of the bomb and torpedo racks. The platform has a folding truss support at each end which bears two attaching lugs. These four lugs fit into the receptacle fittings, Figure 13, in the lower surface of the wing. These fittings may be identified by the stencilled marking "ATTACH BOMB LOADING PLATFORM". Refer to Figure 109 for the installation of the platform.

The portable hoist supporting brackets B.O. Drawing #1609796 that are furnished with left hand racks and #160979-11 furnished on right hand racks, have been removed and replaced by C.A.C. Drawings 28F2115 and 28F2116 on the left hand racks and 28F2115-1 and 28F2116-1 on the right hand racks. The guard tube and cable rollers are mounted between these brackets. These are shown on C.A.C. Drawings 28A5001 and 28A5002.

Bomb and torpedo hoisting directions are given in part "c".

## b. Installation of Racks (Ref.:C.A.C. Drawing 28A2010 and Figure

### (1). Mark XLII Bomb Racks (C.A.C. Drawing 28A2010)

Each Mark XLII rack is attached to the under side of the wing with eight drilled-head bolts 4-5/8" long (AN 75-45). See Figure 110. These bolts pass through mounting holes in the bomb racks, then through spacer rails which adapt the racks to the wing contour, and on into anchor nuts in the wing. The spacer rail used for the rear end of the rack may be distinguished from that used on the front by the notches drilled in it for clearance of the bomb chocks. The drilled-head attaching bolts should be locked with safety wire.

Directly above the location of each Mark XLII rack are two slotted holes side by side in the underside of the wing. Care must be taken that the lever end, which protrudes downward through these slots, is forward of the ends of the release and arming levers of the Mark XLII racks, as the racks are lifted into place. Before attaching the Mark XLII racks it is important to make all the necessary changes in the cable disconnectors described above. This is necessary because the Mark XLII cables in the stowed position are pulled up against the spring load on the levers and, therefore, the levers will not be in the forward ends of their respective slots unless the cables are hooked up properly. Other than this, the Mark XLII cable system is already adjusted and requires no other connections than the correct contact between levers.

On the lower surface of the wing, above each Mark XLII rack location is a small round cover plate held by four

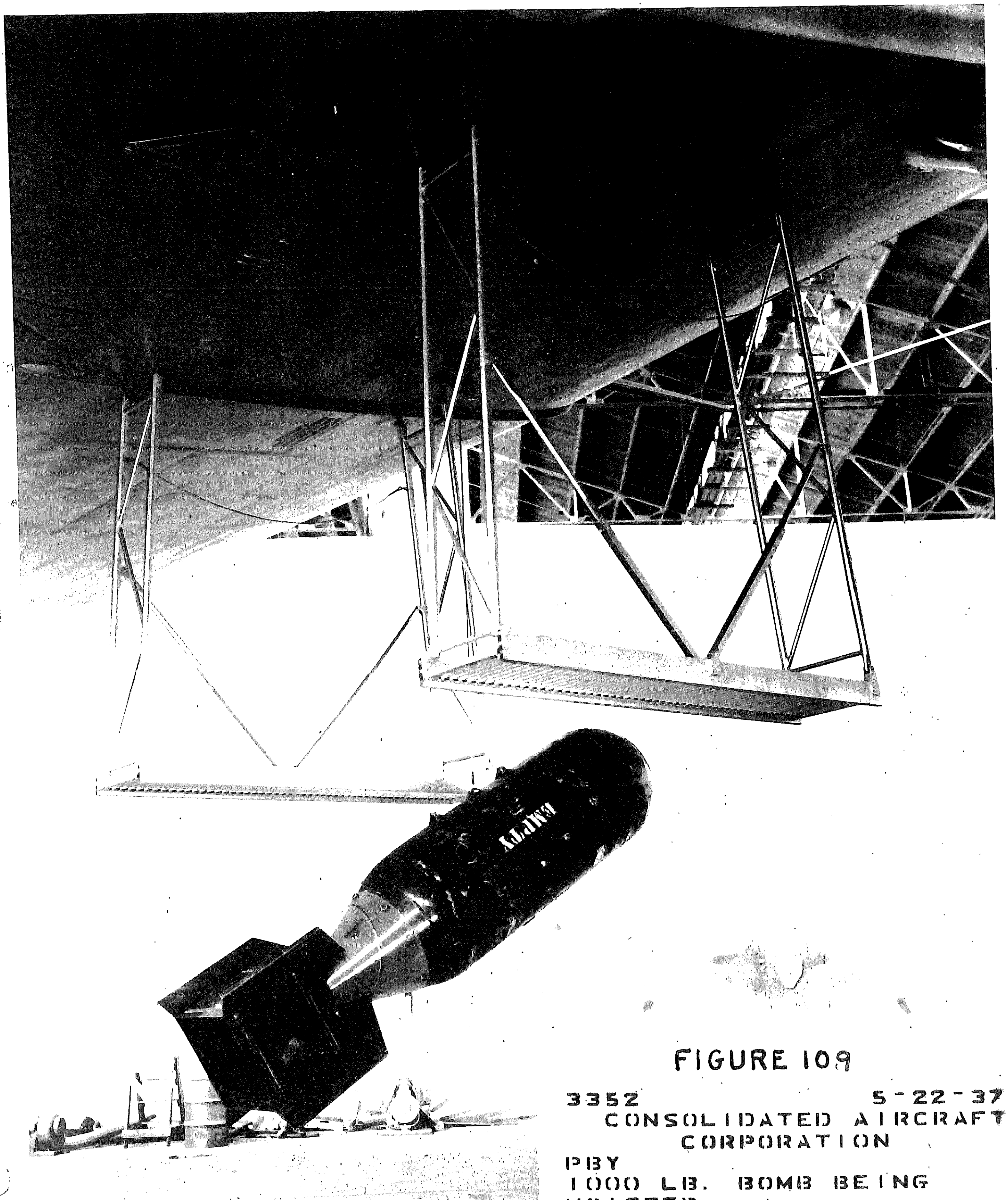


FIGURE 109

3352 5-22-37
CONSOLIDATED AIRCRAFT
CORPORATION
PBY
1000 LB. BOMB BEING
HOISTED.

#6 screws, as shown on Figure 13 . To make the necessary electrical connection this cover plate is to be removed, uncovering a receptacle for the cord and plug from the bomb rack. The four screws are to be replaced in the receptacle and the plug from the rack inserted.

The ends of the arming and release levers on the Mark XLII racks must be smoothed by filing to operate properly against the levers in the wing.

(2) Mark XXXV-6 Bomb Racks (Ref. C.A.C. Dwg. 28A2010)

(a). Removal

The Mark XXXV-6 bomb racks, solenoids and electrical connections may be removed from the airplane, but are intended to remain permanently in place, since they do not, in any way interfere with the operation of the Mark XLII racks when the latter are attached. Removal of the racks is necessary only for alterations in the racks themselves. Ordinary adjustment and cleaning may be performed with the racks in place.

If, for any reason, the Mark XXXV-6 racks are removed from the airplane, care should be exercised in seeing that all structural parts are replaced.

The following procedure should be followed in removing the Mark XXXV-6 bomb racks from the center section.

1. Open the manhole cover in the top of the outer panel near the center section.
2. Enter with tools, extension light, blanket and rags (for removing tallow).
3. Unbolt the two U-brackets straddling the bomb racks.
4. Disconnect the arming and release cables at racks, not at turnbuckles, in order not to lose adjustment.
5. Remove the six bolts holding the bomb rack in place.
6. Tape the control cable ends to the structure if flying without the racks is contemplated.
7. Bolt the U-brackets back in place.
8. Leave the wing with the tools, extension light, blanket, rags, racks and bolts.

9. Replace the manhole cover.

(b) Installation

To install the racks, reverse the above procedure.

(3) Torpedo Racks (Ref. C.A.C. Drawing 28A5001 & 28A5002)

The airplanes are delivered without external torpedo equipment installed. The bolt holes, for attachment on the under side of the wing center section are plugged with a wax grease mixture. It will be necessary to push these wax-grease plugs through the holes, prior to installing the equipment. When the equipment is removed, the holes should be replugged. The torpedo rack installation with the Mark 35-6 bomb rack is covered by C.A.C. Drawings 28A5001 and 28A5002.

Each torpedo rack is attached to the under side of the wing center section with 36 drilled-head bolts (AN74-5) which extend through holes in the rack into anchor nuts inside the wing. The drilled-head bolts should be locked with safety wire. Before installing the torpedo racks, the upper front strut fairings must be removed. The two forward phenolic blocks on the rack are of a greater depth than the two aft ones, so that the Mark 35-6 torpedo rack holds the torpedo parallel to the line of flight.

On the lower surface of the wing above each torpedo rack location is a small round cover plate, Figure 13, held by four #6 screws. To make the necessary electrical connection, this cover plate is to be removed, uncovering a receptacle for the cord and plug from the torpedo rack. The four screws are to be replaced in the receptacle and the plug from the rack inserted. From the receptacle, the cord runs to the two solenoids (Mk. 17-3) which actuate the internal mechanism to operate the torpedo release.

Installed in a similar manner are pulley brackets (C.A.C. Drawing 28F3051, L.H., and 28F2051-1 R.H.), stop bolt (C.A.C. Drawing 28F3045), and propeller-stop (C.A.C. Drawing 28F3011, L.H., and 28F3011-1 R.H.).

The pulley bracket is mounted on the lower side of the leading edge just ahead of the front spar. The release cable from the torpedo rack is threaded through this pulley bracket into a hole provided in the leading edge to a pulley bracket mounted on the front spar. From this bracket the cable extends to attach to a quick disconnector and marked "35 O.B. - 42F" and "28F2093-8", which is on the lower of the three bomb control cables running along the front spar from the hull. When the disconnector is separated to attach the end of the torpedo release cable, the idle disconnector end of the bomb cable should be anchored at the dummy stowage provided on a front spar member. The disconnector is accessible through a marked door in the leading edge of the wing, as shown on Figure 13 . By lying on the wing, one may reach the cables with both hands.

The stop bolt is installed to the rear of the torpedo rack with eight drilled-head bolts. Care should be taken in installation that the end of the slightly tilting bolt extends aft.

The lanyard attaching angle is installed with two drilled-head bolts on the under side of the wing at the centerline of the wing rear spar. A hole is provided in the aft, outside corner of this angle through which a wire is attached which fastens at the opposite end to the top, aft, link on the torpedo. This wire installation is to be made at the time of the torpedo installation.

#### (4) Torpedo Director

##### (a) Installation

The Mark 28-2 torpedo director is installed according to C.A.C. Drawing 28A5054. The director is held in position on the carriage by two screws (AN 505-D10-8) located on the centerline of the carriage. The carriage runs in a slot on the front horizontal track and is left fastened to the track when the director installation is removed.

##### (b) Removal

The front track is detached by removing the four screws that secure it to the brackets. The rear portion of the carriage is provided with two rollers that run in the rear horizontal track. Slots are provided in the rear track so that the carriage can be removed when it is run to the central position.

### c. Hoisting Instructions

#### (1) Bombs

Before hoisting the bombs, the loading platform should be put in place to facilitate the operation. This may be done by attaching the platform to the wing attachment fittings described in Part a-9 and located on Figure 13.

After the T-shaped lug is inserted into the wing receptacle, the locking plunger should be slipped upward and rotated to lock, the folding braces extending between the end trusses and the platform snap-lock to make the platform rigid when opened.

The hoist to be used is the Mark 6 (B.O. 179020) with cable shortened as per C.A.C. Drawing 28A2024, and described in paragraph 8 of Part "a". The positions of the hoist on the upper surface of the wing are located by the holes for anchorage and cable clearance.

The bomb hoist is anchored by means of four pins (C.A.C. Drawing 28A2017). If desired, these pins may be secured to the hoist with chains or other suitable means to prevent their loss while not in use. Set the bomb hoist over the key-hole shaped openings first and insert two of the pins. Then slide the hoist toward the cable opening and insert the remaining two pins into the round holes. This anchors the hoist. Then feed the cable down through the guide tube. The cable must be fed through the bomb rack from below as described above. Due to high mechanical advantage of the hoist care must be exercised when the bomb has reached the rack so that undue strain will not be imposed upon the hoist cable.

Directly beneath each Mark XXXV-6 rack there are three hinged doors held shut by springs for bombing operations, as shown on Figure 111.

At all other times these doors are held closed by screws. These doors must be held open while the bomb is being hoisted and hooked to the rack. After the bomb has been hooked on, the doors will be held partly open by the bomb. When the bomb has been released the doors will snap closed.

Open the two hinged access doors just outboard of the outboard racks and the two doors just inboard of the inboard racks. See Figure 111.

Rig the hoisting cable through these doors.

Attach the end of the cable to the hoisting lug on the bomb.

Feed the hoisting cable through the tubular guide lowered directly to the bomb attaching lugs.

After the bomb has been hoisted and disconnected from the hoist cable, the same procedure must be followed in order to remove the cable from the rack. Extreme care must be exercised here to prevent any attempt to pull the cable through the rack using the hoist. The cable should be removed from the rack by hand; otherwise serious damage to the hoisting gear may result.

(2) Torpedoes (Ref. Figures 113)

The same Mark 6 hoist is used for hoisting the torpedoes. Each torpedo rack attaches to two mark XXXV-6 racks with the torpedo suspended between them when in place. Thus two hoists, one at each Mark XXXV-6 rack, are required to hoist each torpedo (See Figure 108).

The torpedo hoisting band (Ref. C.A.C. Drawing 28A3008) has two lugs, one on each side, for attaching the hoisting cables. The cable end is placed in the lug and secured with a 3/8" bolt (AN6-11) which screws into a nut welded to the lug of the hoisting band. The band is tightened on the torpedo by a take-up nut in the band. For proper alighment when hoisting, the center of the band should be located 31-3/4" forward of the centerline of the stop nut hole on the torpedo. These instructions also appear on the hoisting band. See Figure

When the exercise head is installed on the torpedo, replacing the war head, the balance of the torpedo will be changed. A hold down line should be attached to the nose of the torpedo to aid in balancing while hoisting.

When removing the hoist band, after the torpedo is in place on the rack, slide the stud end of the band between the torpedo and racks to minimize the possibility of catching the hand in the rack mechanism.

Two slings, C.A.C. Drawing 29A017, secure the torpedo to the rack. A turnbuckle is provided at each end of the sling for ready adjustment, as shown in Figure 108.

One end of each sling may be anchored to the rack to avoid loss of the sling when the torpedo is released. The slings should be anchored on opposite sides of the torpedo in order to prevent rolling of the torpedo upon release.

The loading platform used for loading bombs and described in part "a" of this section is also used for loading torpedoes. Sockets are provided in the lower surface of the wing, for attachment of the platform supports. See Figure 13. One platform should be suspended at the inboard side of the torpedo rack and the other outboard of the rack. The sockets provided for these positions are not the ones used for bomb loading.

### d. Bomb Release

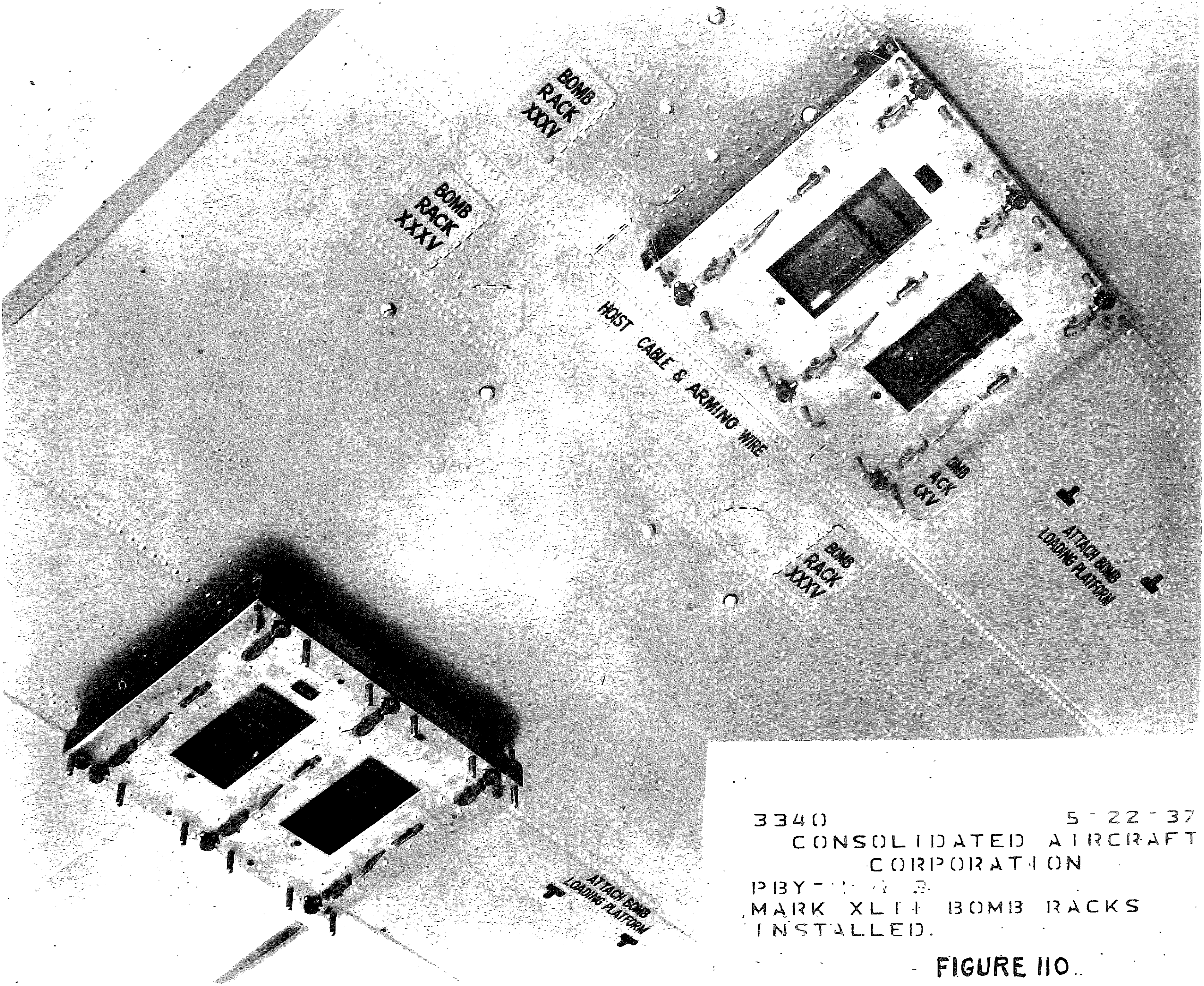
#### (1) Mark XLII Racks

##### (a) Manual Release

The same release handles (Mark XXIX) are used for either the Mark XXXV-6 or Mark XLII bomb rack manual control.

In the Mark XLII system the release handles on the port side of the airplane operate the port bomb racks; those on the starboard side, the starboard racks.

Three release handles and one arming handle are on each of the two units. The outboard handle simultaneously releases all the bombs on the forward rack and the inboard handle


BOMB RACK XXXV
BOMB RACK XXXV
HOIST CABLE & ARMING WIRE
BOMB RACK XXXV
ATTACH BOMB LOADING PLATFORM
ATTACH BOMB LOADING PLATFORM

3340 5-22-37
CONSOLIDATED AIRCRAFT
CORPORATION
PBY-1 & 2
MARK XLII BOMB RACKS
INSTALLED.

FIGURE 110.

simultaneously releases all the bombs on the rear rack. The upper center handle simultaneously releases all the bombs on both the forward and rear racks.

The lower central handle arms both front and rear racks and due to excess spring tension, it is necessary to hold it in the "ARMED" position with the lock provided on the bottom of the control box. All handles are operated by pulling aft.

### (b) Manual Electric Release

The Mark XLII and Mark XXXV-6 bomb racks may be fired electrically from the equipment on the port side of the bomber's compartment or from the auxiliary station in the pilot's compartment. The bomber's equipment and the switch panel is described in part "a" of this section. Nameplates on the panel identify the twelve bomb release and the four arming switches.

To release a bomb from the Mark XLII rack:

1. Insert firing key plug in Firing Key Receptacle on panel. The key is strapped to the bomber's hand.
2. Arm rack desired by closing switch to "ARM" position.
3. Close Selector switch for bomb to be released.
4. Close switch marked "Manual". This lights a red indicator light to show that system is ready for operation by firing key.
5. Release bomb by depressing Firing Key.

The key must be operated for each bomb or combination of bombs to be released. Bombs may be released singly by closing only one selector switch or in groups by closing as many switches as desired.

In the event that the pilot is to release the bombs, the selection and arming must be performed by the bomber as outlined above. The pilot must then:

1. Plug pilot's firing key into pilot's firing key receptacle on electrical control panel.
2. Close Bomb Release switch.
3. Depress firing key to release bomb.

### (c) Automatic Electrical Release

For automatic bomb release, the bombs are selected and armed in a manner similar to (b) above.

The procedure is as follows:

1. Insert firing key in Firing Key Receptacle on panel.

2. Arm rack desired by closing switch to "ARM" position.

3. Close Selector switch for bombs to be released.

4. Close switch marked "Automatic". This lights the white indicator light and connects the release circuits to the Mark XV bombsight. The Manual switch remains in the "OFF" position.

5. When the objective is properly aligned by the bombsight optical system, the sight mechanism will automatically release the bombs.

### (d) Emergency Release

To release the bombs in emergency, the pilot must pull the Salvo Release handles on his instrument panel. Each handle will release the bombs on its respective side of the airplane in the "SAFE" condition.

## (2) Mark XXXV-6 Racks

### (a) Manual Release

Bombs in Mark XXXV-6 racks may be released manually by the release handles in the bomber's compartment described in Part 3-a of this section. Each set of release handles controls the racks on its respective side of the airplane.

To arm the bombs, the lower handle on the control group must be pulled aft to the "ARM" position. This arms all bombs on rack.

To release the outboard bombs in the rack, the outboard Release Handle should be pulled.

To release the inboard bombs on the rack, the inboard Release Handle should be pulled.

To release both bombs on either the port or starboard rack, the upper center Release Handle should be pulled.

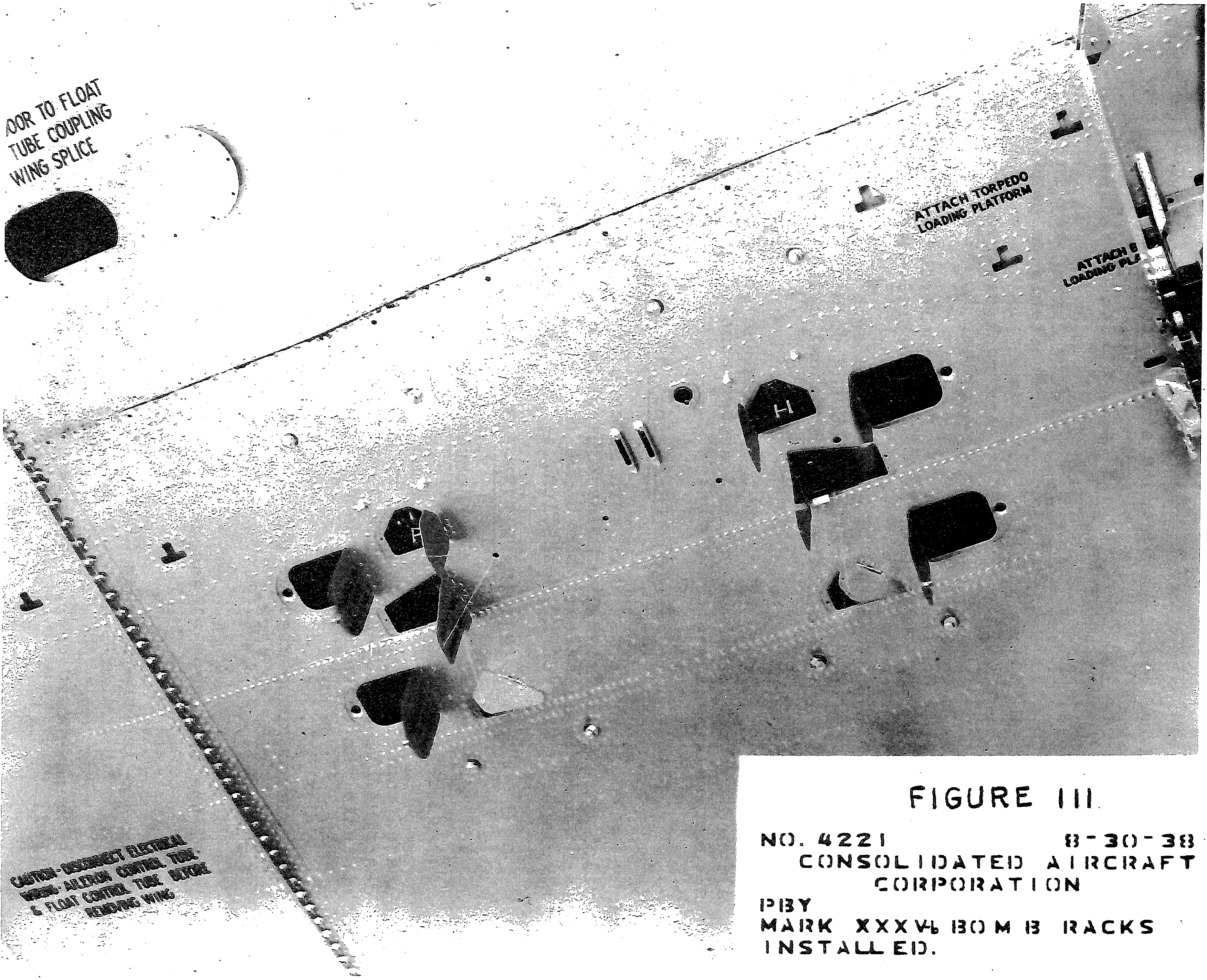
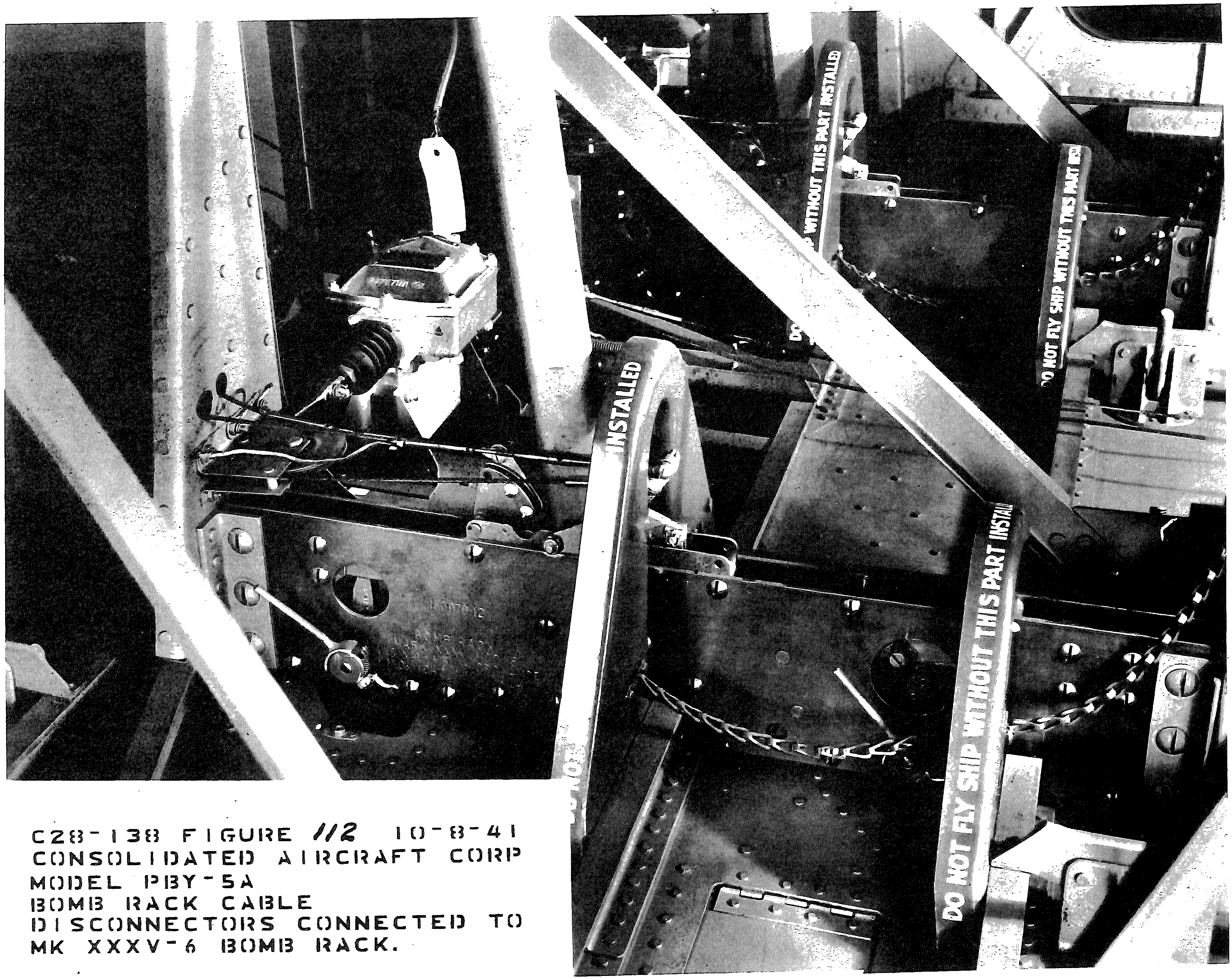


FIGURE III

NO. 4221 8-30-38
CONSOLIDATED AIRCRAFT
CORPORATION
PBY
MARK XXXV-6 BOMB RACKS
INSTALLED.


DO NOT FLY SHIP WITHOUT THIS PART INSTALLED
DO NOT FLY SHIP WITHOUT THIS PART INSTALLED
DO NOT FLY SHIP WITHOUT THIS PART INSTALLED

C28-138 FIGURE 112 10-8-41
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A
BOMB RACK CABLE
DISCONNECTORS CONNECTED TO
MK XXXV-6 BOMB RACK.

### (b) Manual Electrical Release

Manual electric release of bombs in the Mark XXXV-6 racks should be accomplished by the following procedure:

1. Arm bombs in rack desired by pulling manual arming handle aft to "ARM". The lower center lever is the arming control.

2. Insert firing key plug in firing key receptacle on panel. The key is strapped to the bomber's hand.

3. Close selector switch for bomb to be released.

4. Close "Manual" switch. This lights a red indicator light to show that the system is ready for operation by the firing key.

5. Release bomb by depressing firing key.

The key must be operated for each bomb or combination of bombs to be released. The bombs from these racks may be released singly by closing only one selector switch, or in groups by closing as many switches as desired.

In the event that the pilot is to release the bombs, the selection and arming of the bombs must be performed by the bomber as outlined above. The pilot must then:

1. Plug firing key into his firing key receptacle on the electrical control panel.

2. Close bomb release switch.

3. Depress firing key to release bomb.

### (c) Automatic Electric Release

With the Mark XXXV-6 racks, the bombs are armed manually as described in (a) and (b), above.

1. Arm the bombs in the racks desired.

2. Switch desired selector switches to "RELEASE".

3. Close "Automatic" switch. This lights the white indicator light and connects the release circuits to the Mark XV bombsight. The manual switch remains in the "OFF" position.

4. When the objective is properly aligned by the bombsight optical system, the sight mechanism will automatically release the bombs.

(d). Emergency Release

The emergency release procedure is the same for all bomb loadings. The pilot can drop the entire bomb load by pulling on the emergency release handles on the pilot's instrument panel.

e. Torpedo Release

(1). Manual

The pilot may release the torpedoes by pulling the release handles on the pilot's instrument panel. These handles are used for emergency bomb release when bombs are carried. When used with the torpedoes, the port emergency release handle releases the port torpedo and the starboard handle the starboard torpedo.

(2). Electrical Release

The electrical release of the torpedoes is controlled from switches on the starboard end of the pilot's electrical switch panel. Refer to Part 3-a of this section.

To fire a torpedo, the switch on the extreme end of the pilot's electrical switchboard should be closed to the "TORPEDO RELEASE" position. This opens the bomber's release circuit and prevents the bomber from inadvertently firing the torpedo.

To release the torpedoes electrically, the NA41A firing key plug is inserted in the receptacle marked "Firing Key" on the panel, the key itself being strapped to the hand of the pilot or co-pilot. The torpedo is then selected by closing the proper switch, located on the panel just above the firing key receptacle. The right and left torpedoes are identified by nameplates appearing above the two switches.

If it is desired to release both torpedoes simultaneously both switches are to be closed. The selected torpedo is released by pressing the firing key.

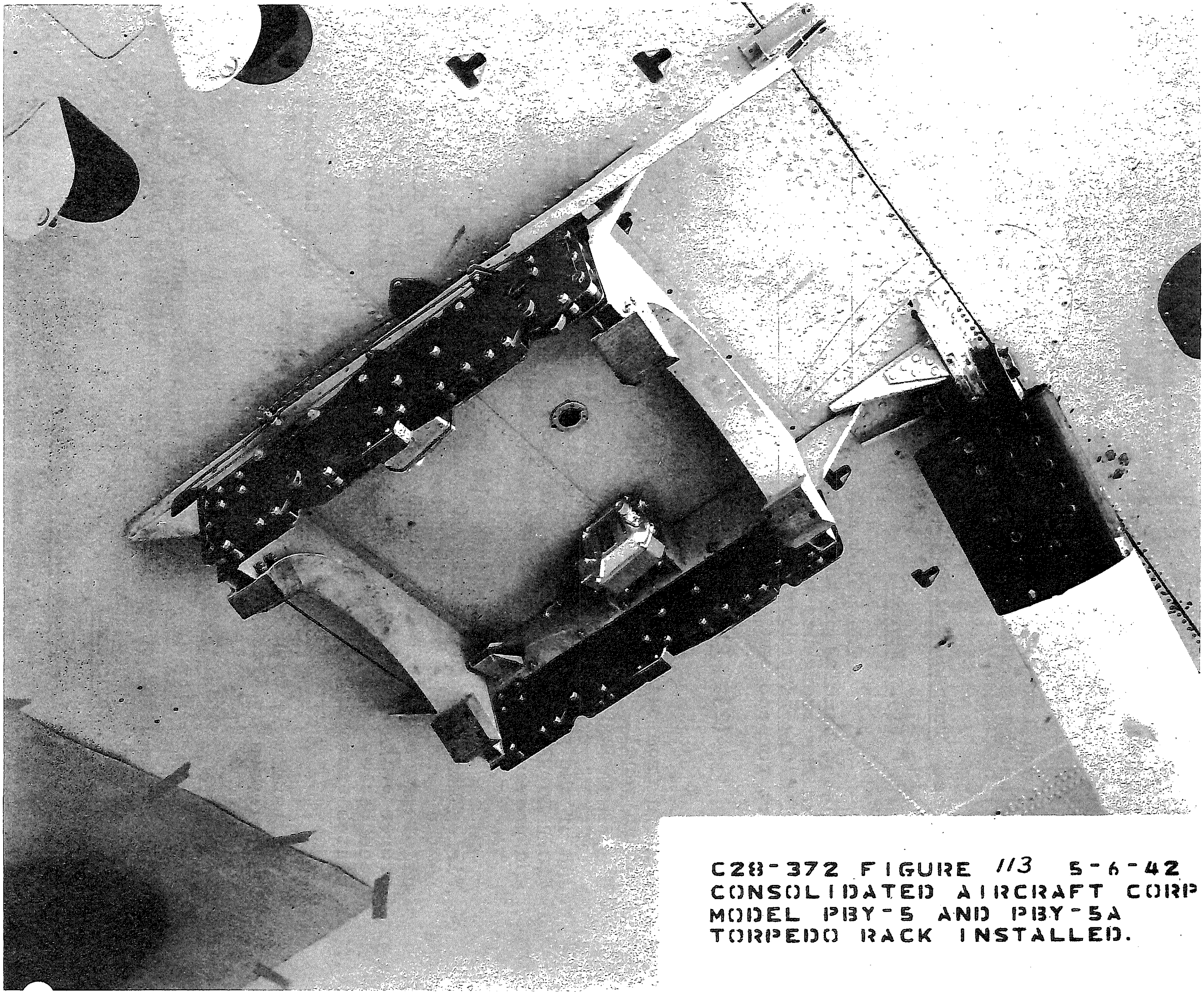
(3). Torpedo Director

The Mark XXVIII torpedo director may be used by either the pilot or co-pilot. It is described in Part 3-a.

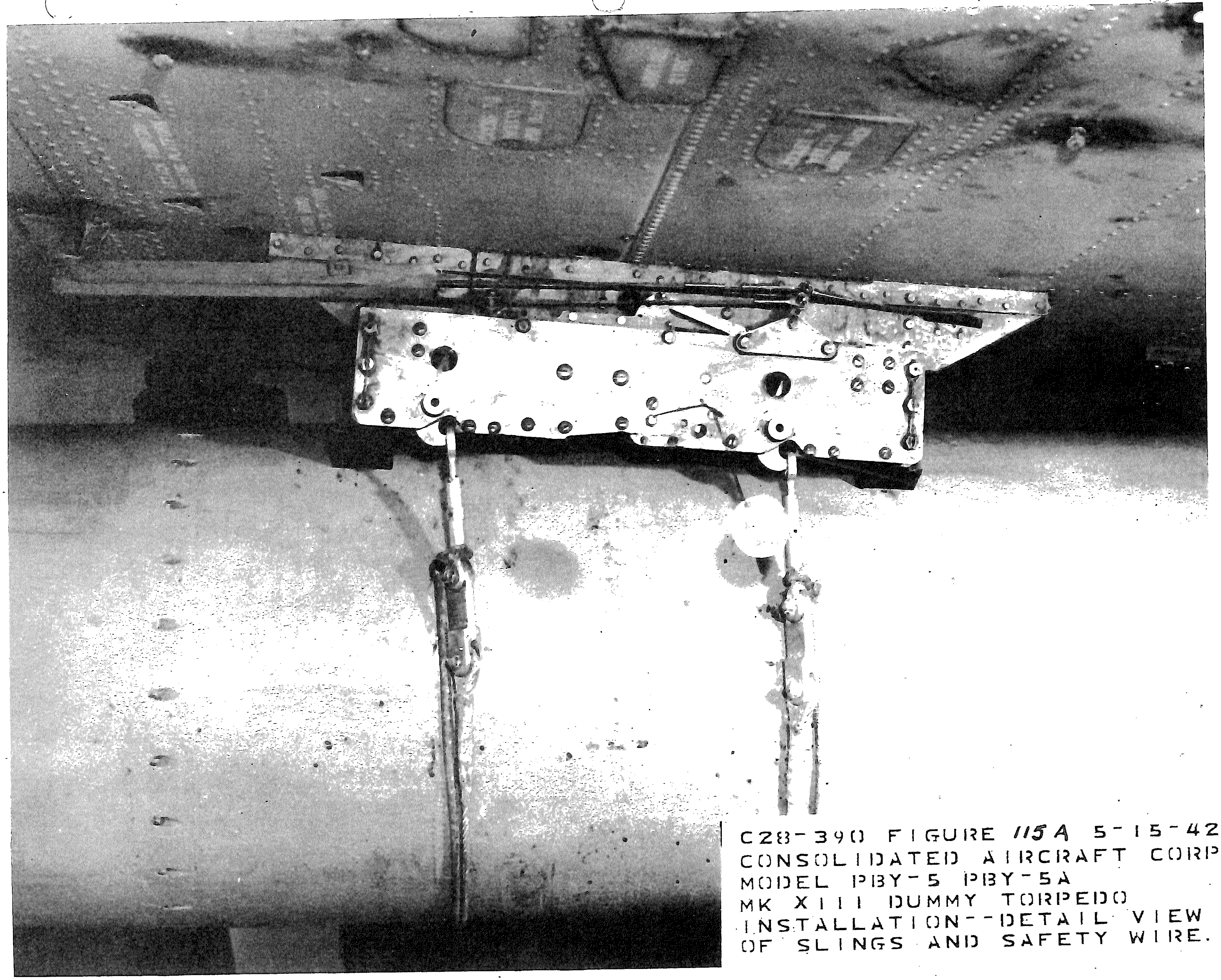
f. Servicing

(1). Bomb Rack Mechanism

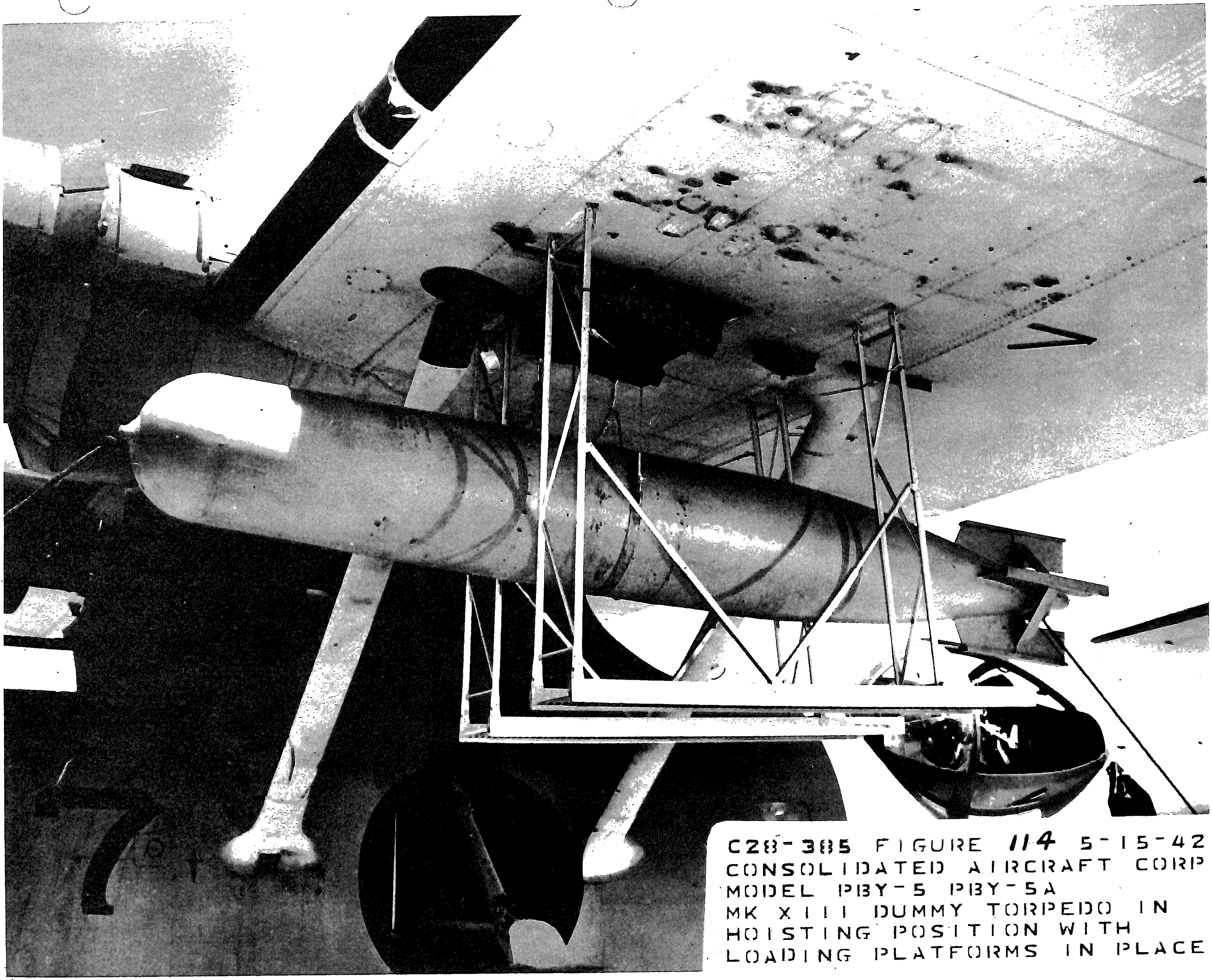
The bomb rack mechanism should be tested for proper



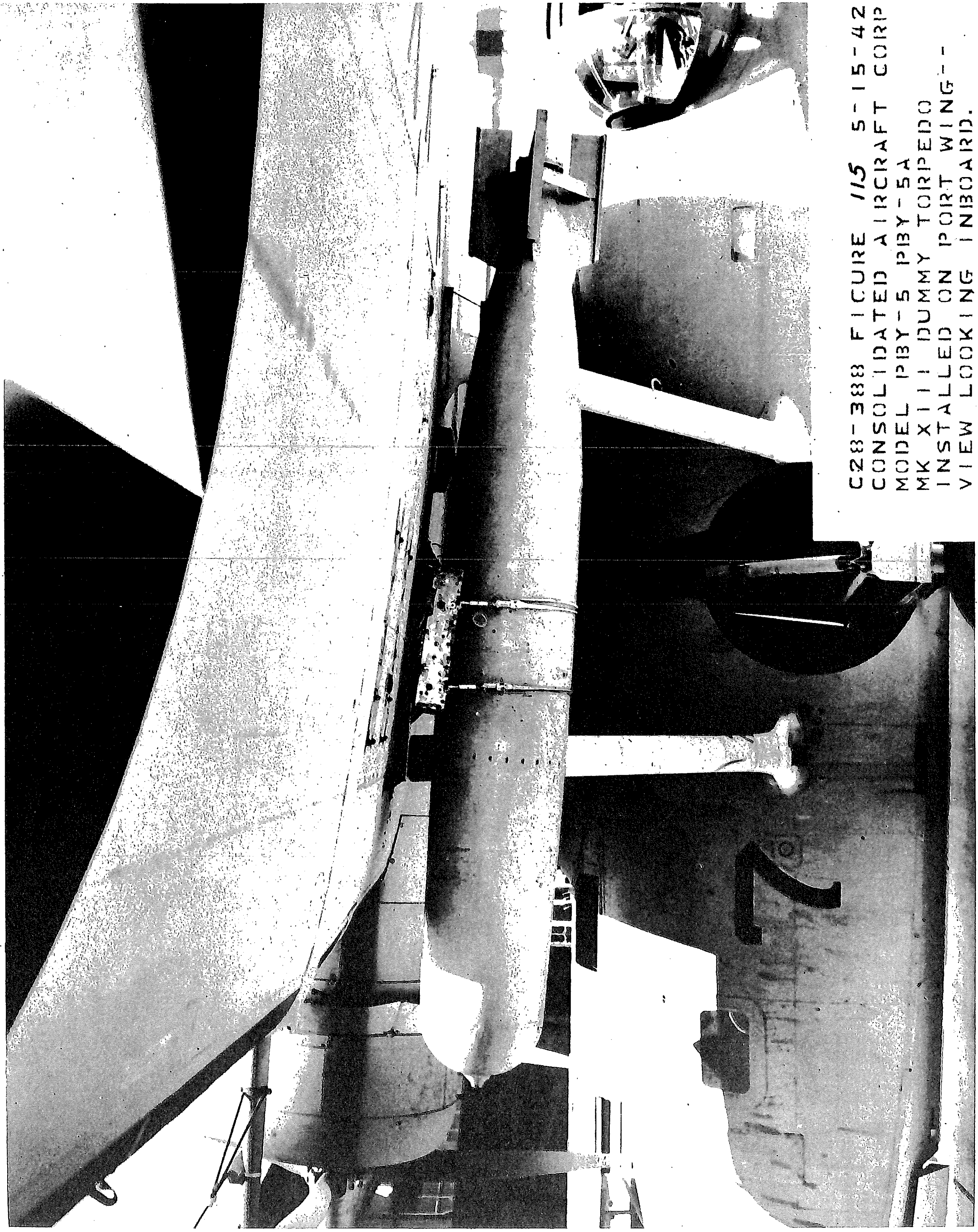
C28-372 FIGURE 113 5-6-42
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5 AND PBY-5A
TORPEDO RACK INSTALLED.



C28-390 FIGURE 115A 5-15-42
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5 PBY-5A
MK XIII DUMMY TORPEDO
INSTALLATION--DETAIL VIEW
OF SLINGS AND SAFETY WIRE.



C28-385 FIGURE 114 5-15-42
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5 PBY-5A
MK XIII DUMMY TORPEDO IN
HOISTING POSITION WITH
LOADING PLATFORMS IN PLACE



C28-388 FIGURE 115 5-15-42
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5 PBY-5A
MK XIII DUMMY TORPEDO
INSTALLED ON PORT WING--
VIEW LOOKING INBOARD.

operation, inspected, cleaned and oiled before each flight on which bombs are carried.

(2). Release Systems

The manual and electrical release systems should be tested for proper operation before each bomb load is installed. Contacts on the electrical relay system should be kept clean.

The manual release system should be inspected at every engine overhaul period.

(3). General

Inspect the following:

(a). The manual release handles.

(b). The cables for fraying, especially where they enter Bowdenite casings or run over pulleys and for looseness. Adjustments may be made at the turnbuckles on the forward face of bulkhead #4.0.

(c). The pulleys and brackets, making sure that the pulleys turn freely and that the cables run over the pulleys.

(d). The turnbuckles and connections. Make sure they are properly safetied.

(e). All bonding connections. They must be clean and tight.

(f). The bomb release handles, cables and pulleys in the hull. The cables and turnbuckles on the front face of bulkhead #4.0 can be checked through access doors provided in the front part of the superstructure. The pulleys at the center of the wing on the front face of the front spar may be inspected through one of the doors in the top surface of the leading edge. The cables running along the front spar may be easily checked at engine overhaul time. The solenoids, connecting links and control cable connections can be inspected through the access doors in the lower surface of the wing.

Light duty control pulleys are used extensively in the bomb release and arming controls due to the light loads. These light duty pulleys may be replaced with AN Standard pulleys if the light duty pulleys are not available when replacements are required.

#### (4) Torpedo System

The torpedo system should be inspected and maintained in the same manner as the bomb racks and controls. The correct procedure is described in Part (3) above.

### g. Lubrication

#### (1) Bomb Racks

Oil the bomb rack mechanism with light machine oil before each flight on which bombs are carried.

Access to the pulleys and brackets, for lubrication and inspection, is provided for through the access doors described in Part (3) above.

#### (2) Access Doors

Lubricate all bombing access door hinges and fittings with light machine oil before each flight on which bombs are carried.

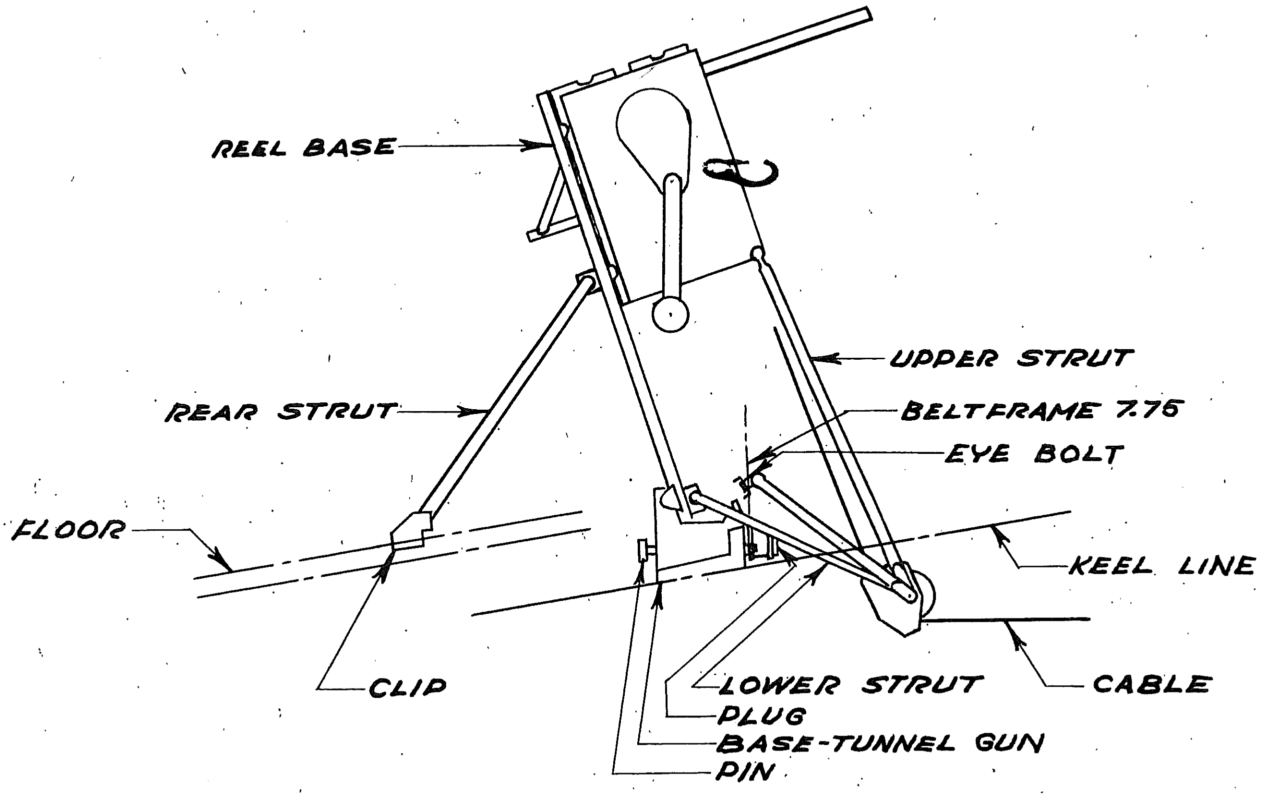
## 4. Armor Plating (Ref. C.A.C. Dwgs. 28U5077, 5056, 5058, 5043, 5073, 5071 and 5069)

The following armor plating is installed in PBY-5A airplanes. Two armor plates aft of bulkhead #8, one on each side of the airplane; two armor plates on the tunnel gun; two on each side waist gun; four in the bow gun turret, one attached to each side of the gun carriage and one on each side of the gun; on both port and starboard sides and on the aft end of the superstructure for protection to the fuel units and fuel tank sump; and in the wing rear spar on both sides of the airplane. Armor plated pilot's seats are also provided (Government furnished) which provide protection on sides, back and seat.

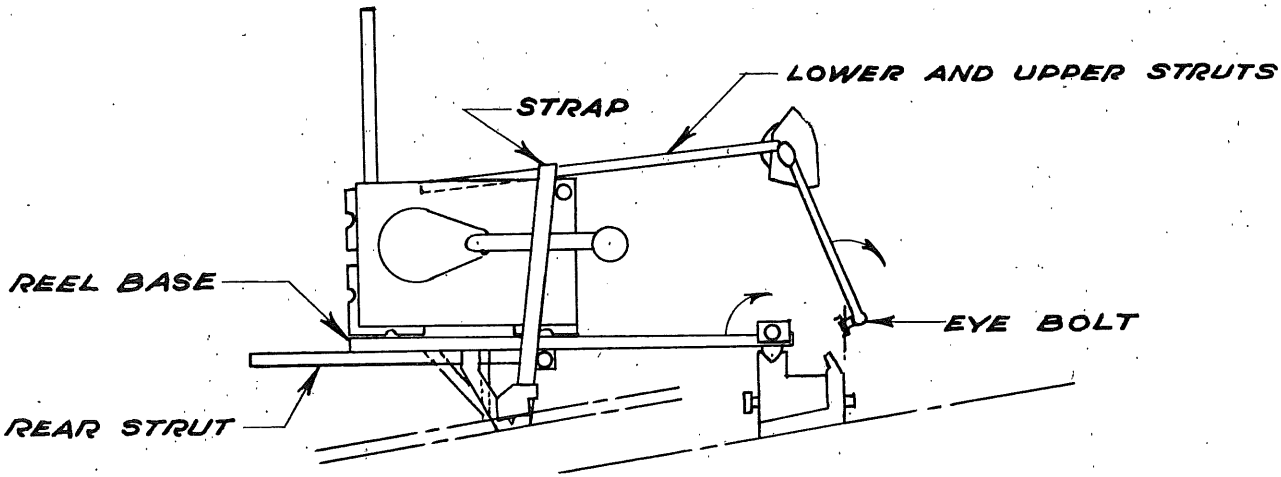
## 5. Target Towing Reel (Ref. C.A.C. Dwg. 28A5080)

### a. Description

Provision is made for the installation of a Mark VII target towing reel. The reel is mounted on the V-brace where the tunnel gun stirrup is normally mounted, between bulkheads #7 and #8. The reel is supported at three points with the towing reel projecting through the tunnel entrance and below the keel. A reel and crank, for winding in the towing line, is supported on the tow-reel frame. (See Figure 130)



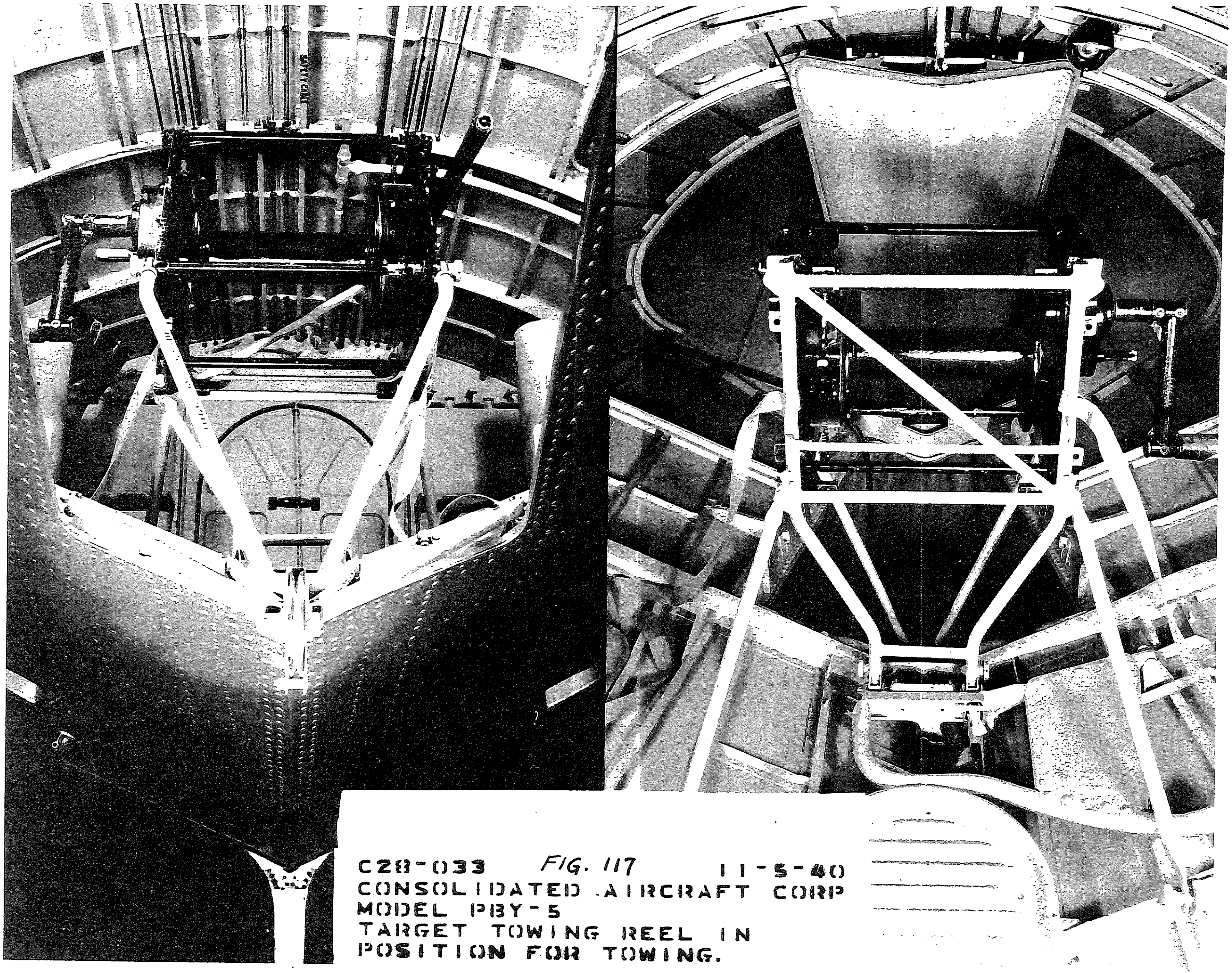
IN POSITION FOR TOWING



IN STOWED POSITION

REFER TO C.A.C. DWG. 28A5080

FIGURE 116
TARGET TOWING REEL



C28-033 *FIG. 117* 11-5-40
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5
TARGET TOWING REEL IN
POSITION FOR TOWING.

In the stowed position the reel and frame is folded forward and secured to the floor by the straps provided as shown on Figure

b. Installation (Ref. Figure 117)

To install the towing reel follow the procedure given below:

(1) Remove gun stirrup from Vee-Brace.

(2) Attach towing reel base to vee-brace with same nuts and bolts as were used for stirrup.

(3) Secure Vee-Brace to stirrup base with bolt provided.

(4) Attach reel to reel base.

(5) Assemble sheave, upper and center struts, to lower strut.

(6) Attach center struts to eye-bolts.

(7) Assemble socket and plug to the lower strut.

(8) Attach rear struts to reel base.

(9) Secure reel base to floor, then to struts with stowage straps provided.

c. Removal

To remove the towing reel reverse the above procedure.

d. Operation

When the reel is to be used, observe the following instructions:

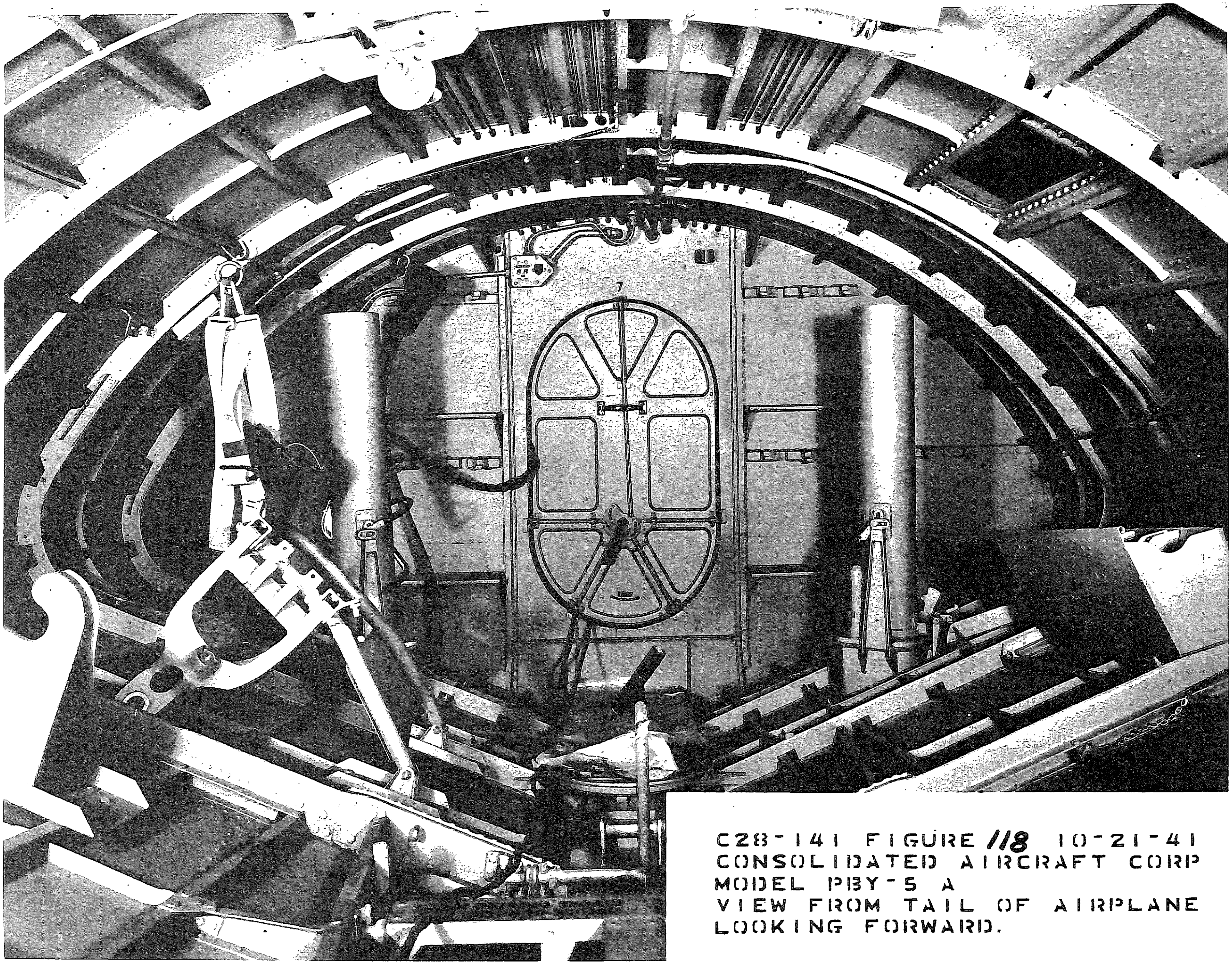
(1) Loosen hold down straps.

(2) Swing sheave down into position.

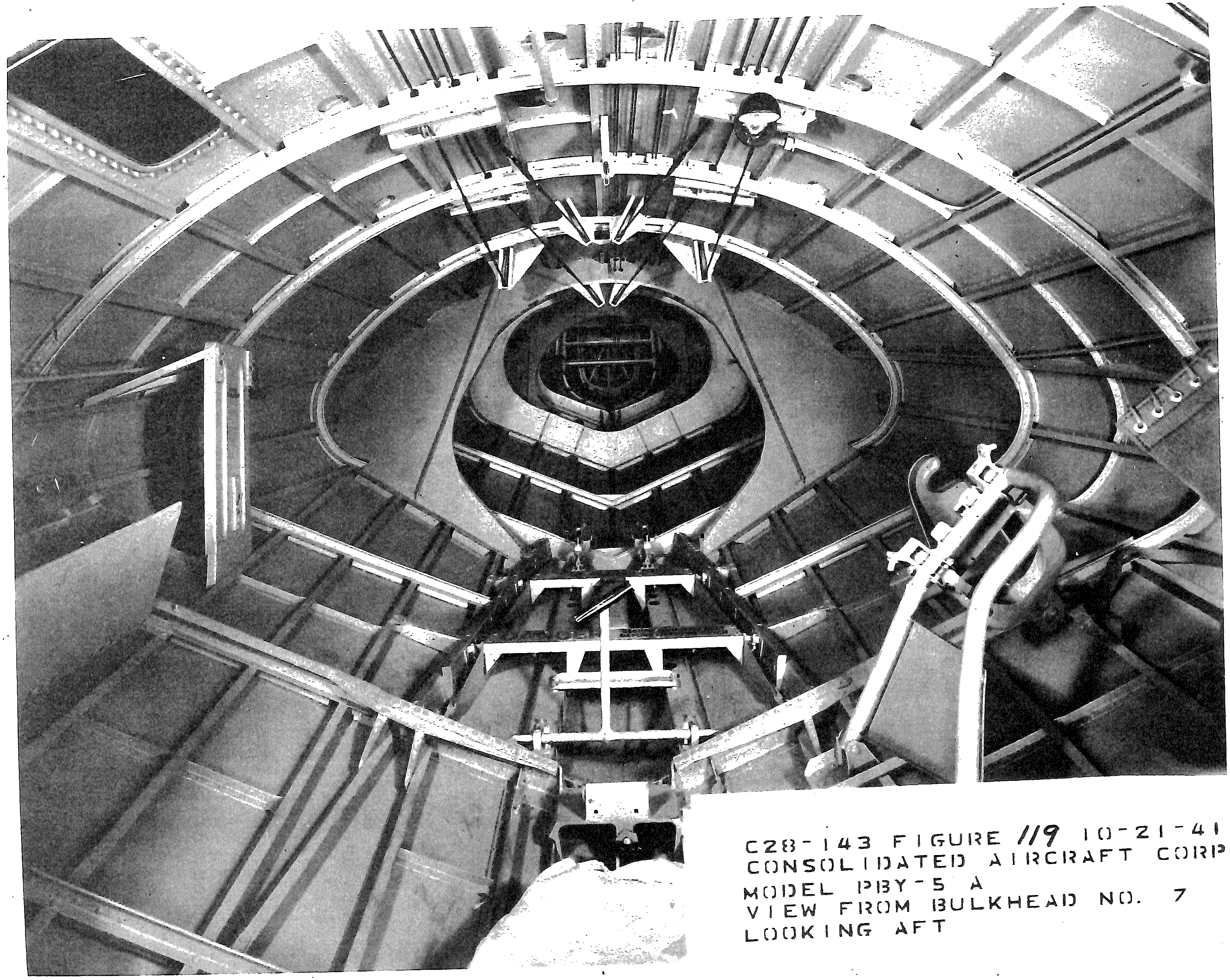
(3) Raise reel base.

(4) Attach lower strut to the base with nuts provided.

(5) Attach rear struts to clips located on each side of airplane centerline.



C28-141 FIGURE 118 10-21-41
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5 A
VIEW FROM TAIL OF AIRPLANE
LOOKING FORWARD.



C28-143 FIGURE 119 10-21-41
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5 A
VIEW FROM BULKHEAD NO. 7
LOOKING AFT

(6) Tighten installation with pin located under stirrup base.

(7) Adjust and attach upper reel struts and eyebolts to reel with nuts provided.

## D. Pyrotechnics

### 1. Very's Pistol Installation (Ref. C.A.C. Dwg. 28A5100 and 28A5055 )

One Very's pistol is located on the starboard side of the hull in the pilot's compartment. Two containers for 24 rounds of Very's ammunition is located just aft of the pistol holster.

A second pistol and two additional containers carrying 24 rounds of ammunition are located on the starboard aft face of bulkhead #6.

Description of the M-7 installation will be included when available.

### 2. Parachute Flares (Ref. C.A.C. Dwg. 28A1006)

Two Mark V-2 or V-3 aircraft parachute flares are carried in flare adapters just aft of beltframe #7.25, on either side of the hull. Racks are provided to stow these flares when landing, taking off, or in the water. Twelve additional flares are stowed in their shipping containers under the navigator's table. Six additional flares in their shipping containers may be stowed in the removable rack on top of the fixed rack.

Two stowage racks are provided, one resting on the other. When the flares are exhausted from the upper rack, four wing nuts are removed and the empty upper rack may be lifted away, giving access to the flares in the lower rack.

To load the adapter with a new flare:

a. Raise the toggle locking handle. Lift container from base and swing it into a horizontal position.

b. Release latch to open door at bottom of container.

c. Insert flare, top end first.

d. Hook ring on flare tearing strip into snap hook provided, after removing ring left from previous flare.

e. Close and latch door over fabric strip.

f. Swing container into a vertical position and lower toggle locking handle.

Care should be taken that the safety latch is snapped over the release lever on the flare adapter.

Flares are released by pulling the type M-2 handles located above the door in the pilot's compartment. Each handle is connected to a cable which runs aft through the hull to the flare adapters. Each handle releases the flare stowed on its respective side of the airplane.

3. Smoke Grenades (Ref. C.A.C. Dwg. 28A5100)

A pouch for two H.C. smoke grenades, type M-8, is located on the starboard side, aft face of bulkhead #6. A smoke grenade handle is stowed above the starboard .50 caliber ammunition rack.

4. Float Lights (Ref. C.A.C. Dwg. 28F2012)

Four racks are provided on the rear face of bulkhead #7 for stowage of 18 Mark IV Aircraft Float lights. They are stowed in the racks with the nose down, fitting in a flanged hole and the tail secured by a spring clip at the top.

To remove a float light, raise the spring clip at the top. Tip the light aft and lift out.

## 5. Smoke Tank (Ref. C.A.C. Dwg. 28A2008; Figures 120, 121, 122 & 123)

### a. Description

A Mark V, Model 1 smoke tank is installed on the lower surface of the port wing center section just outboard of the wing struts. The tank is held in place by one Mark XXXV-6 bomb rack.

A $CO_2$ tube leads from the tank into the wing down through the superstructure to a $CO_2$ bottle located on the aft face of bulkhead #5 on the port side of the door. The bottle is held on its bracket by two metal straps with trunk fasteners so that it can readily be removed for re-charging. A pressure gage and seat type valve at the top of the bottle control the carbon dioxide to the smoke tank.

Two pulley brackets are located on the lower surface of the wing just aft and above the smoke tank installation. The tank control cable from the wing extends around these pulleys and connects on to the aft end of the smoke tank where the release valve is located.

The discharge tube, extending back and down from the smoke tank, is held in place by a brace which connects to a bracket on the lower surface of the wing.

The smoke tank control is located over the door on the aft face of bulkhead #5. The control is manually operated and consists of a cable leading to the aft end of the smoke tank. The bulkhead is marked for the "ON" and "OFF" positions of the handle.

### b. Operation

The smoke tank is controlled by the tee handle on the aft face of bulkhead #5. When the handle attached to the control cable is in the "DOWN" position the smoke control is "ON"; when in the "UP" position the control is "OFF". A bracket for the cable stowage is provided above the control handle.

The $CO_2$ system is operated by the valve on the bottle.

### c. Installation (Ref. C.A.C. Dwg. 28A2008)

For more detailed installation instructions refer to C.A.C. Report No. ZI-28-038, "Instructions for Installing Mark V, Model 1 Smoke Tank", dated July 24, 1940.

(1) Attach the 28A1110 lugs to fittings on top of smoke tank with nuts and bolts, as shown on C.A.C. Dwg. 28A2008.

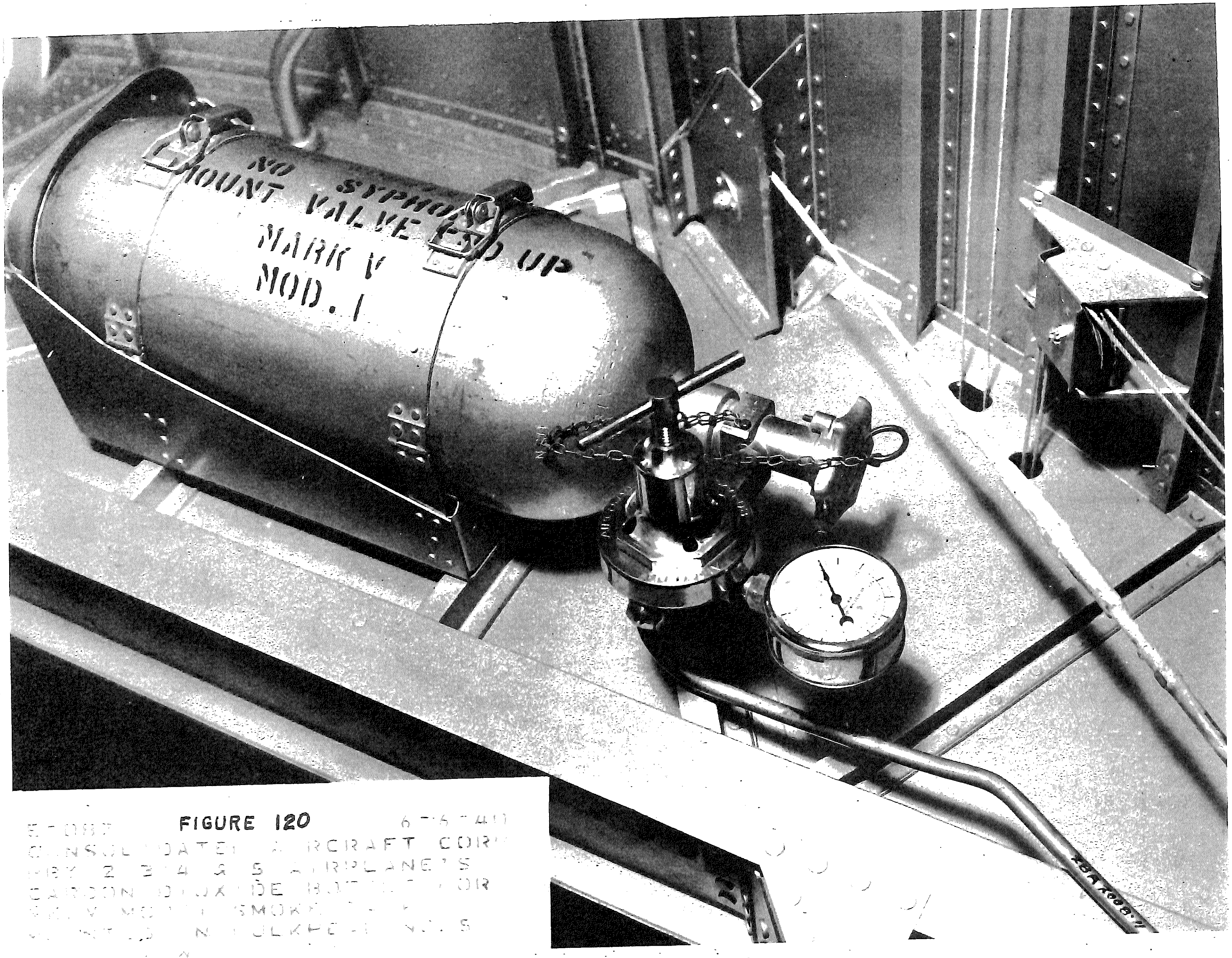
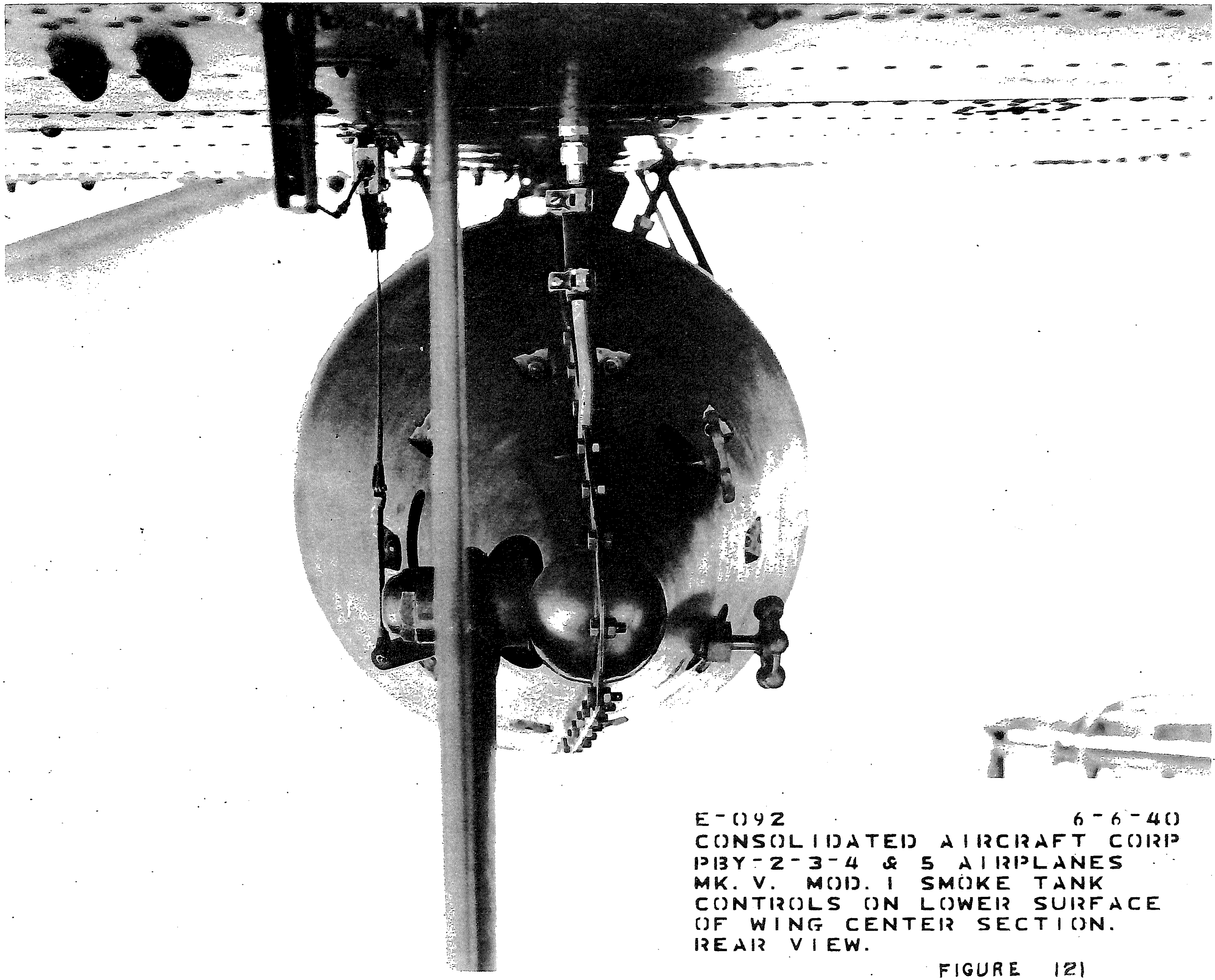


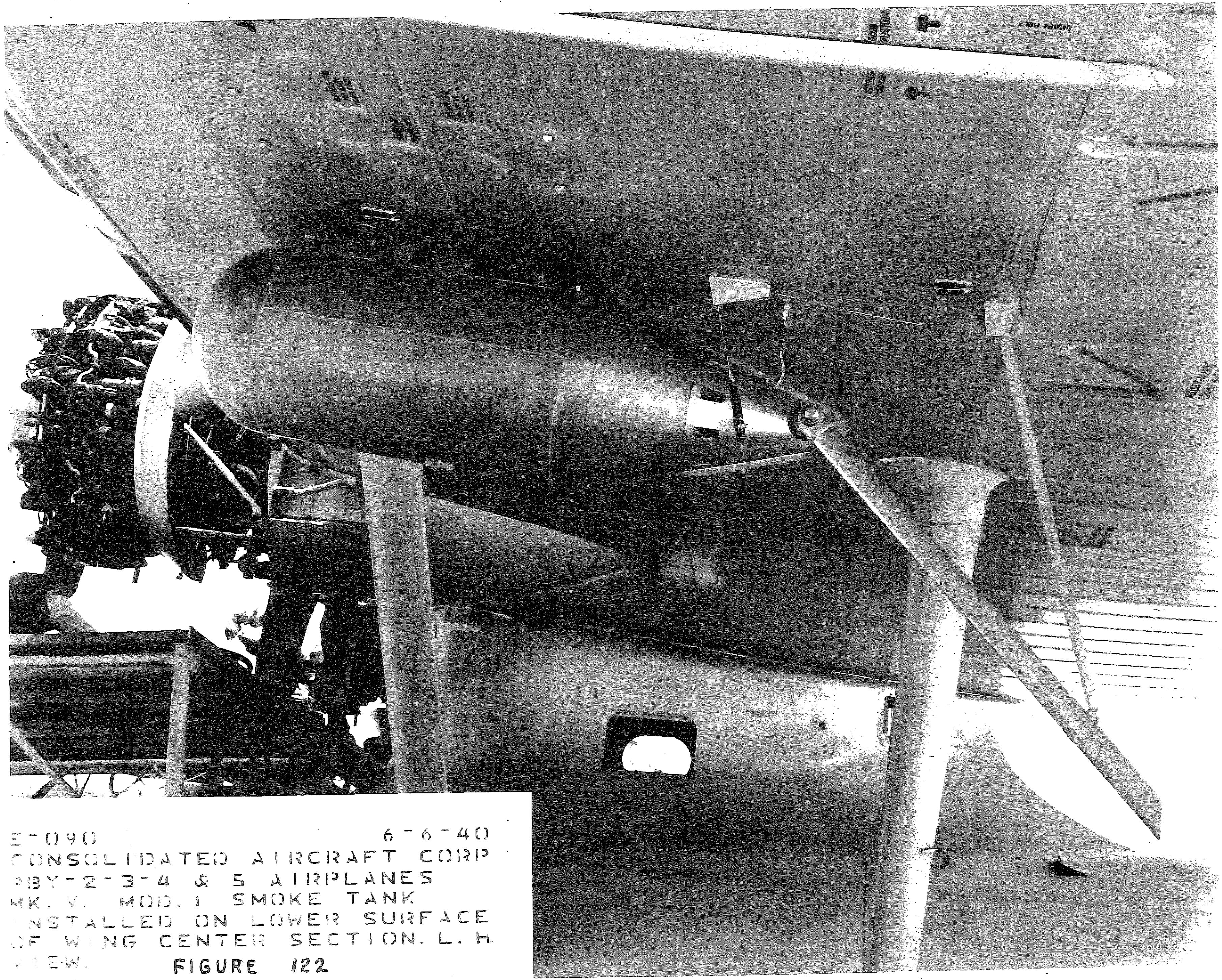
FIGURE 120

E-087 6-6-40
CONSOLIDATED AIRCRAFT CORP
XPBY 2 3 4 & 5 AIRPLANE'S
CARBON DIOXIDE BOTTLE FOR
MK V MOD I SMOKE TANK
MOUNTED ON BULKHEAD NO. 5



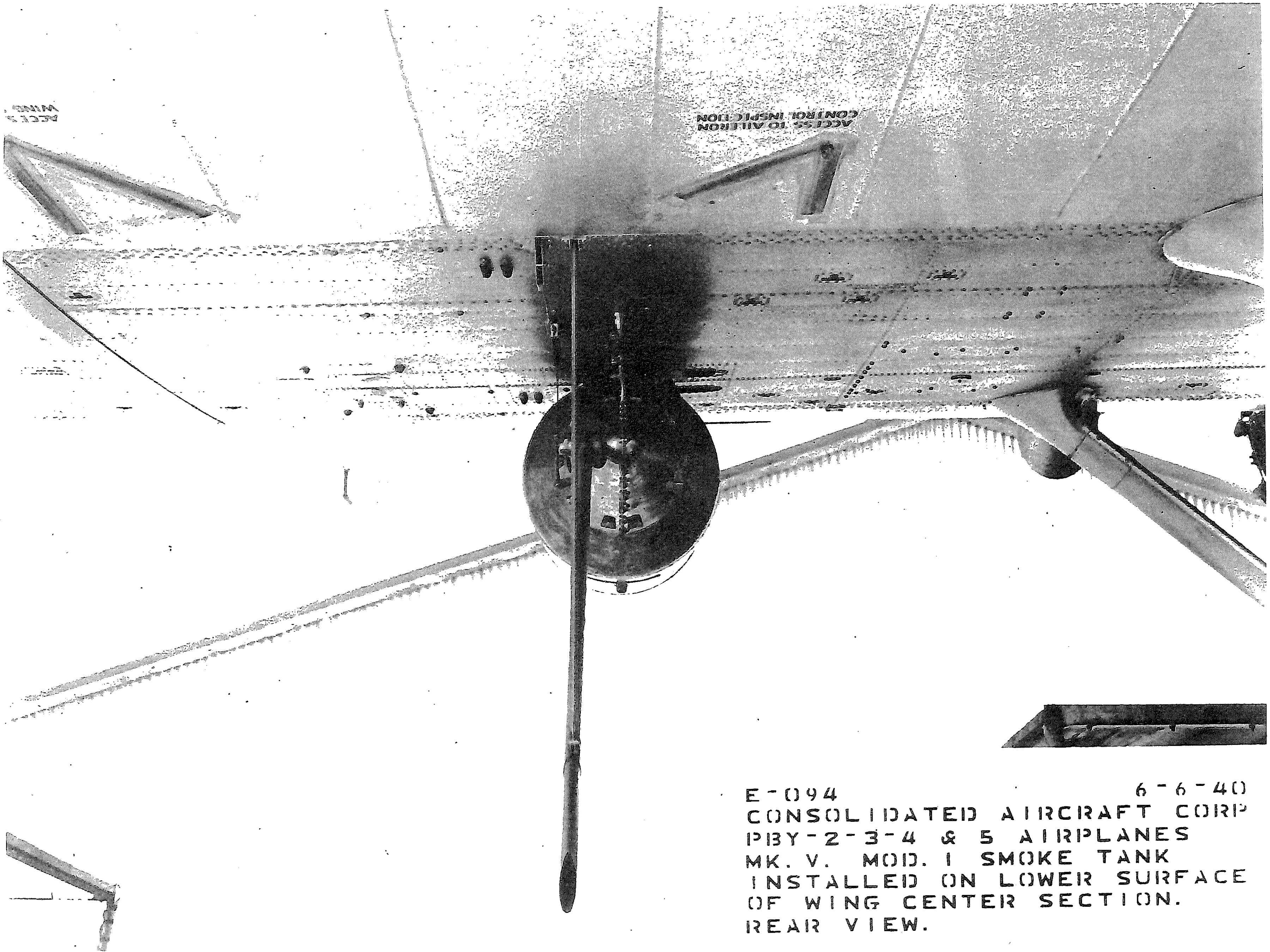
E-092 6-6-40
CONSOLIDATED AIRCRAFT CORP
PBY-2-3-4 & 5 AIRPLANES
MK. V. MOD. I SMOKE TANK
CONTROLS ON LOWER SURFACE
OF WING CENTER SECTION.
REAR VIEW.

FIGURE 121



E-090 6-6-40
CONSOLIDATED AIRCRAFT CORP
PBY-2-3-4 & 5 AIRPLANES
MK. V. MOD. 1 SMOKE TANK
INSTALLED ON LOWER SURFACE
OF WING CENTER SECTION. L. H.
VIEW.

FIGURE 122



E-094 6-6-40
CONSOLIDATED AIRCRAFT CORP
PBY-2-3-4 & 5 AIRPLANES
MK. V. MOD. 1 SMOKE TANK
INSTALLED ON LOWER SURFACE
OF WING CENTER SECTION.
REAR VIEW.

FIGURE 123

(2) Hoist tank to wing and attach tank by lugs to the left hand inboard of Mark XXXV-6 bomb rack.

(3) Install pulley bracket and fairleads on rear spar of port wing as shown on 28A2008.

(4) Install $CO_2$ bottle brackets, cable stowage bracket, and release handle bracket on bulkhead #5.

(5) Install pulley brackets on lower surface of the wing center section. Where the round head screw plug for the Mark XLII bomb rack mounting hole interferes, use holes on forward end of inboard flange of bracket which clears bomb rack mounting nut plate.

(6) Install smoke tank tube strut. Adjust to approximately 40° down from centerline of smoke tank by sliding clamp along tube. Tighten clamp.

(7) Install tubing from $CO_2$ bottle to smoke tank.

(8) Install cable from bulkhead #5 to smoke tank.

d. Disassembly

(1) Disconnect cable assembly from turnbuckle barrel. Remove brackets on wing lower surface and replace screws to plug holes. Slide off cable assembly by removing pulley. Disconnect $CO_2$ tube nipple from bulkhead fitting at lower surface of wing center section. Release smoke tank from bomb rack and lower it from wing.

(2) Attach aft terminal (cable assembly) to the 28A1079 nut, as shown on 28A2008. Draw cable into wing and attach nut to rear spar flange. Cover protruding end of $CO_2$ tube bulkhead fitting with Parker #6 PFD cap.

(3) At bulkhead #5, hook cable around spools on bracket and stow handle under clip.

(4) Disconnect $CO_2$ tubing from $CO_2$ bottle valve. Remove bracket assembly from supports.

NOTE: It is recommended that the trailing edge be removed for ease of $CO_2$ tube and release cable installation. However, it is possible to make the installation through the zipper openings in the fabric without removing the trailing edge.

Revised 4/1/42
C.A.C.

## E. Communicating Equipment (Ref. C.A.C. Dwg. 28U5009, Figure 124)

### 1. Radio Equipment

#### a. G.O. Unit

Provision is made for the installation of the G.O. series long range radio equipment in the radio compartment. Refer to Figure 124 for the cording diagram. The equipment consists of:

1 Transmitter - Model GO-5, GO-6, GO-7 or GO-9. The model used is optional.
2 R.U. series receivers and mounting bases.
2 R.U. receiver dynamotors.
1 D.W. series direction finder.
1 G.F./R.U. series intra squadron equipment.
1 Model ZA instrument landing equipment.
1 R.L.-24A interphone system.
1 Flameproof key.
1 Frequency meter and base, type LM.
1 Antenna reel with Model "J" wire and fish.
1 Lead-out insulator stand pipe and plug.

The G.O. transmitter is located just forward of the radio operator's table where it is secured to the mounting base. A support prevents swaying. See by Figure

The two R.U. receivers are designated as first and second receiver. The first receiver is located at the forward end of the shelf above the radio table and the second receiver is at the aft end. The junction boxes are attached to the underside of the shelf. The switch boxes are attached to a bracket at the rear of the radio table. Brackets are located under the table at beltframe #3.66 for mounting three dynamotors.

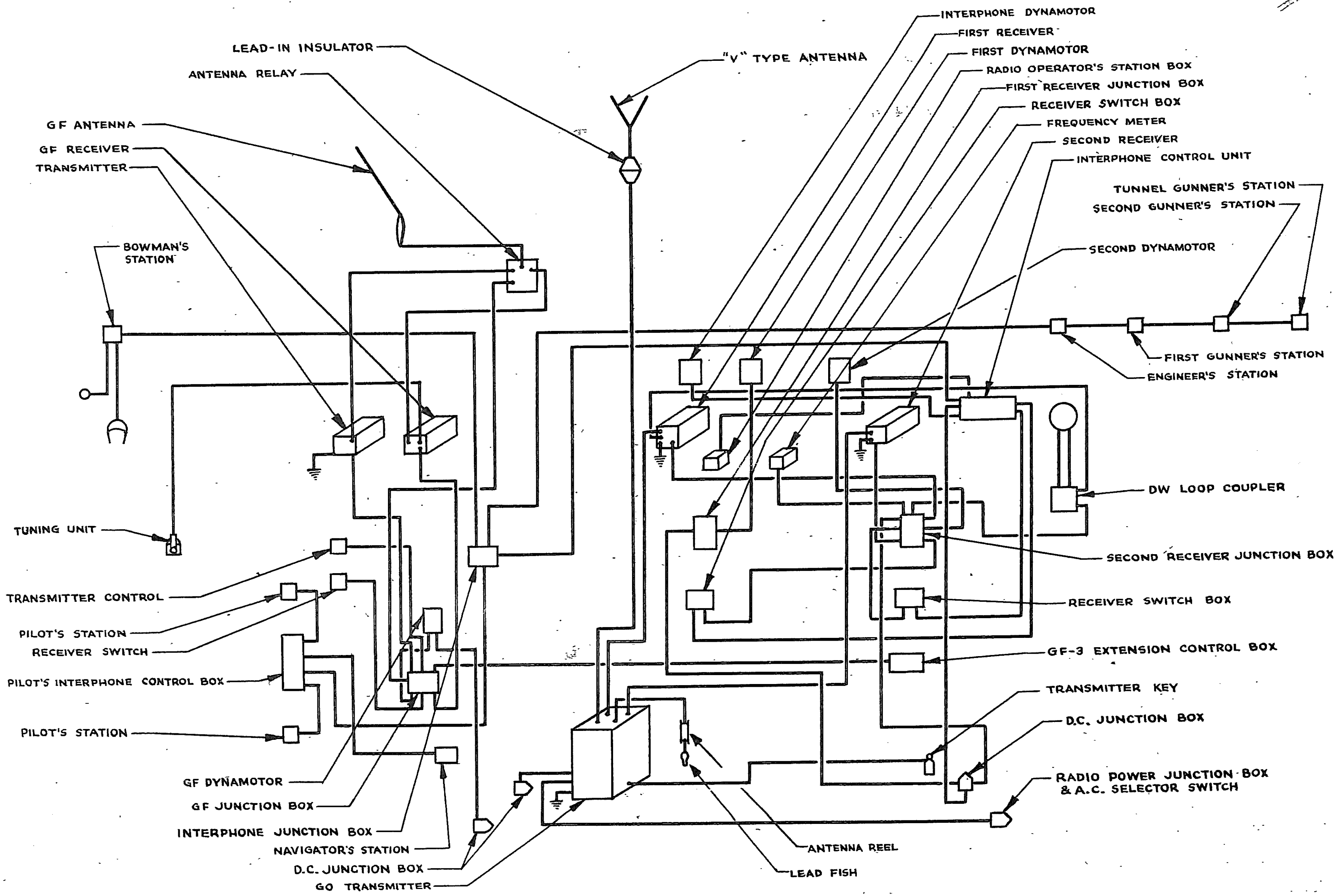
The antenna reel, lead-out insulator and standpipe are all located on the starboard side of the hull forward of the operator's table. The reel is attached to the side of the hull aft of bulkhead #3.0.

A plug stowed at the aft face of bulkhead #3.0 is used for sealing the standpipe when the insulator is not in use. This plug is provided with an upper and a lower plate and gasket to insure a watertight seal. The same stowage clips are used for stowage of either the insulator or the plug.

The frequency meter is located on the shelf between the first and second receivers.

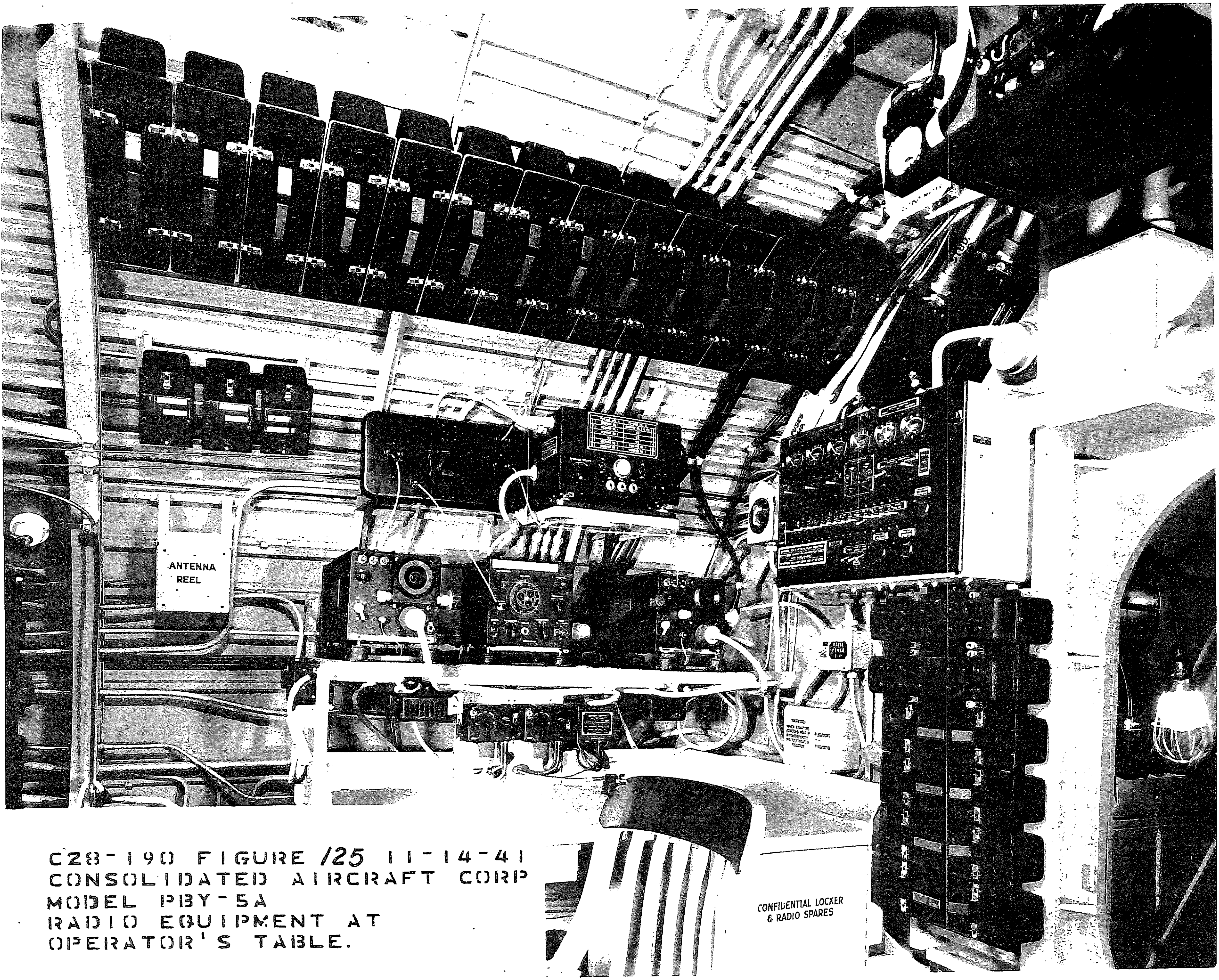
The transmitting key is located on the table where holes are provided for mounting.

Provision has been made for stowage of 20 receiver coil sets and 3 transmitter coil sets. Six of the receiver coil

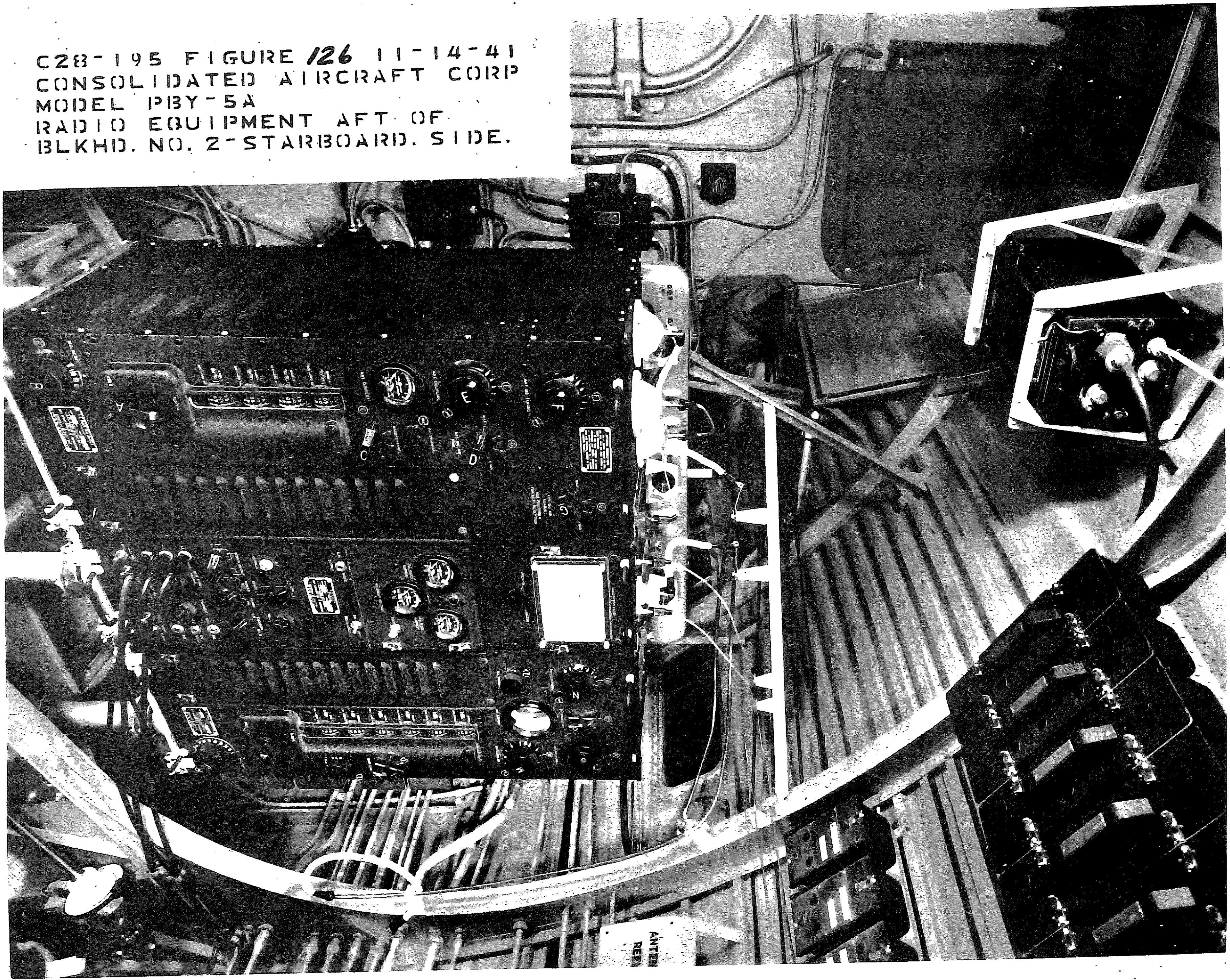


REFER TO CONSOLIDATED DRAWING 28U5008

FIGURE 124
COMMUNICATIONS CORDING DIAGRAM



C28-190 FIGURE /25 11-14-41
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A
RADIO EQUIPMENT AT
OPERATOR'S TABLE.



C28-195 FIGURE 126 11-14-41
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A
RADIO EQUIPMENT AFT OF
BLKHD. NO. 2-STARBOARD. SIDE.

sets fit on racks on bulkhead #4.0 and fourteen over the radio table between bulkheads #3.0 and #4.0. Three spare transmitter coils are stowed on the rack above the antenna reel, and below the receiver coil rack.

### b. Intra-Squadron Maneuvering Unit

Provision is made for the installation of G. F. Series intra-squadron maneuvering equipment in the radio compartment. Figure 125 illustrates the general arrangement. The cording diagram is shown in Figure 124.

The G.F. equipment consists of:

1 Transmitter and base.
1 Receiver and mounting base.
1 Transmitter control box.
1 Receiver switch box.
1 Extension control box.
1 Antenna relay unit.
1 Junction box.
1 Dynamotor unit.
1 Receiver remote tuner.
1 Phantom antenna.
8 Coil set containers.
9 Receiver coils.
3 Coil set containers.
4 Transmitter coils.

The transmitter control box is located on the forward face of bulkhead #2.0 on the starboard side of the pilot's compartment. The receiver switch box is mounted directly opposite on the port side of bulkhead #2.0 in the pilot's compartment. The receiver remote tuner is below the switch box just outboard of the pilot's interphone control. It is connected to the receiver by a flexible torque shaft. Figure 43 illustrates the pilot's radio controls.

The G.F. extension control box, attached to the forward edge of the radio shelf, is operable by the radio operator. Spare coils are stowed in the racks described in preceding paragraph "a". The remainder of the G.F. equipment is installed on the aft face of bulkhead #2.0 in the radio compartment.

The power supply is obtained from the junction box which is connected to the distribution panel on the starboard side of bulkhead #4.0 as shown in Figure 125.

The remaining parts of the G.F. equipment are mounted on the starboard side of the aft face of bulkhead #2.0. Clips on the bulkhead provide for attaching the flexible shaft and radio cording.

### 2. Radio Direction Finder (Ref: C.A.C. Drawing 28U5009)

A manually operated direction finder loop is installed on the airplane.

The equipment consists of:

1 Coupler unit.
1 Azimuth scale.
1 Rotating mechanism.
1 Direction finder loop, Type DW
1 Output meter.

The coupler unit is located on a mount in the top of the radio compartment just forward of bulkhead #4.

The circular azimuth scale and manually operated rotating mechanism is mounted just above the coupler unit and sets around the base of the loop shaft.

The type DW direction finder loop is mounted above the top surface of the leading edge of the wing and located on the center-line of the ship. The loop shaft passes vertically down through the superstructure and terminates at the loop coupler unit located in the radio operator's compartment, as described above.

Provision is made for an output meter on the starboard side of the loop rotating mechanism.

Cording is shown by Figure 124.

3. Interphone Unit (Ref. C.A.C. Drawing 28F5085)

An interphone unit with nine stations is installed to permit communication among the crew members. The unit is Model RL-24-B equipped with Type T-38 microphones.

The equipment consists of:

Interphone control unit.
Pilot's control box.
2 pilot station boxes.
7 crew station boxes.
Interphone junction box.
Interphone dynamotor.
9 clips for microphones.
9 microphones, Type T-38.
9 headsets, Type 38610.
1 set connecting cables.

The interphone control box is located in the radio operator's compartment above the shelf just forward of bulkhead #4.

The pilot's control box is installed in the pilot's compartment above the door on the forward face of bulkhead #2.

The pilot's station box is installed on the port side of the hull in the pilot's compartment. The co-pilot's station box is located similarly on the starboard side.

The station boxes for members of the crew are distributed through the airplane in the following manner: The first and second gunner's boxes are located over the door on the aft face of bulkhead #6, one on each side. The tunnel gunner's station box is installed on the port side of the hull on beltframe #7.5. The bomber's box is in his compartment on the starboard side of the hull on forward side of beltframe #0.66. The flight engineer's box is in his compartment in the superstructure aft of bulkhead #4. The navigator's station box is attached to his table in the navigator's compartment. The radio operator's station box is located underneath his table at the forward inboard corner.

The interphone junction box is installed on the aft face of bulkhead #2 on the starboard side.

The interphone dynamotor is located under the radio operator's table on the starboard side of the ship.

There are nine clips and hooks provided for supporting the microphones and headsets. One clip and hook is located by each of the eight station boxes and in the radio operator's compartment just below the shelf on the forward side.

For the cording diagram see Figure 124.

4. **Antenna Installation** (Ref. C.A.C. Drawing 28U2004)

The antenna system consists of a "V" type antenna, an antenna for G.F. radio, a trailing antenna and a Radar installation. Refer to Figure 127 for the antenna diagram.

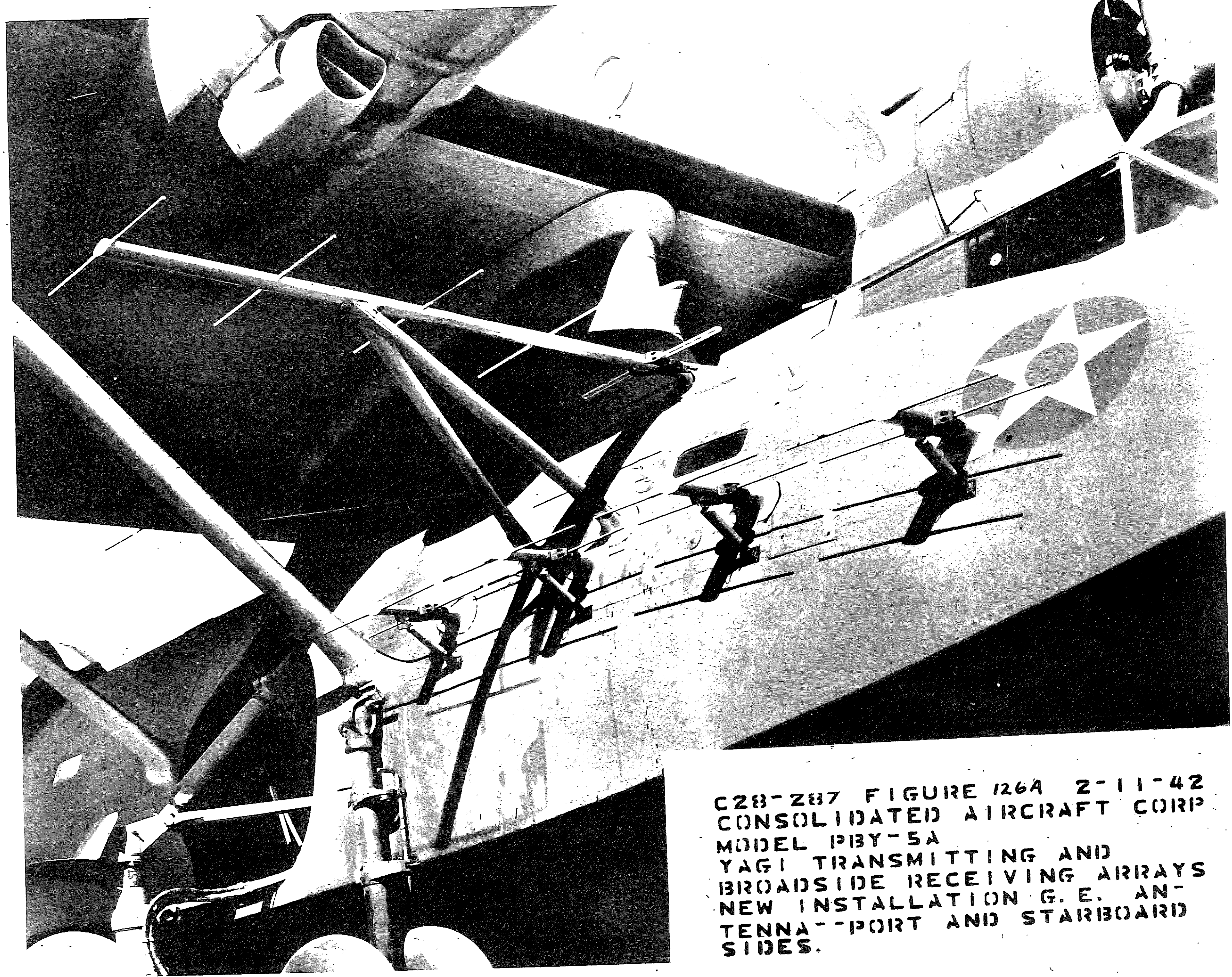
The "V" antenna consists of Model "J" antenna wire. It extends from a mast on the port wing tip through the insulator at the peak of the vertical fin to a mast on the starboard wing tip. A "lead-in" is taken from the starboard side of the antenna and goes to a "lead-in" insulator. The "V" antenna is approximately 100 ft. long. The "lead-in" is approximately 46 ft. long.

The antenna for the G.F. radio extends from a fitting on the leading edge of the wing, down to an insulator on the starboard side of the hull forward of beltframe #2.5. The antenna is approximately 20 ft. long.

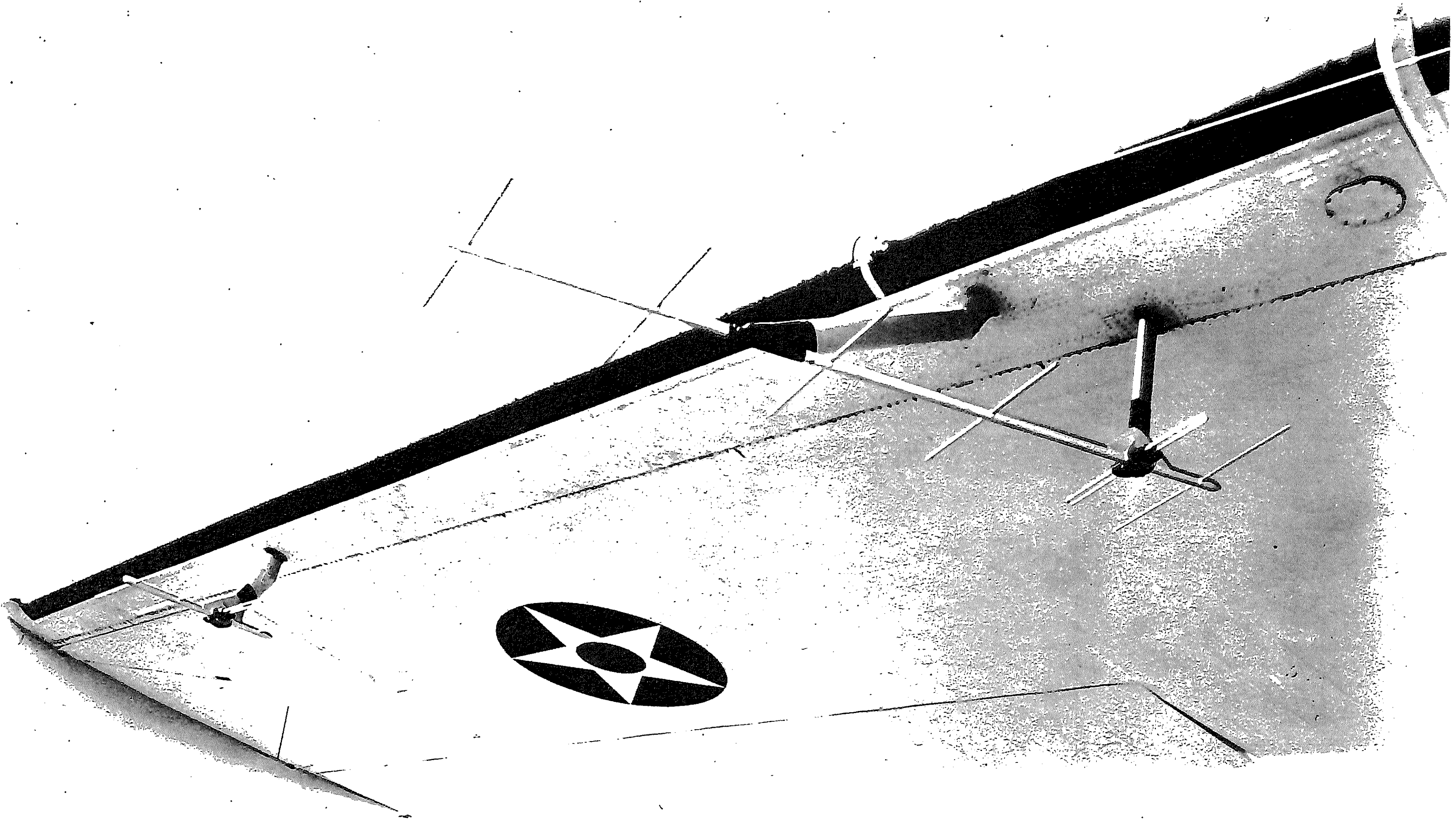
For a description of the trailing antenna, refer to the GO Series radio equipment.

The antenna should be installed when the airplane is out of the water. Access to the wing tip is accomplished by walking along the front spar. Walkways are provided along the hull deck and the horizontal stabilizer.

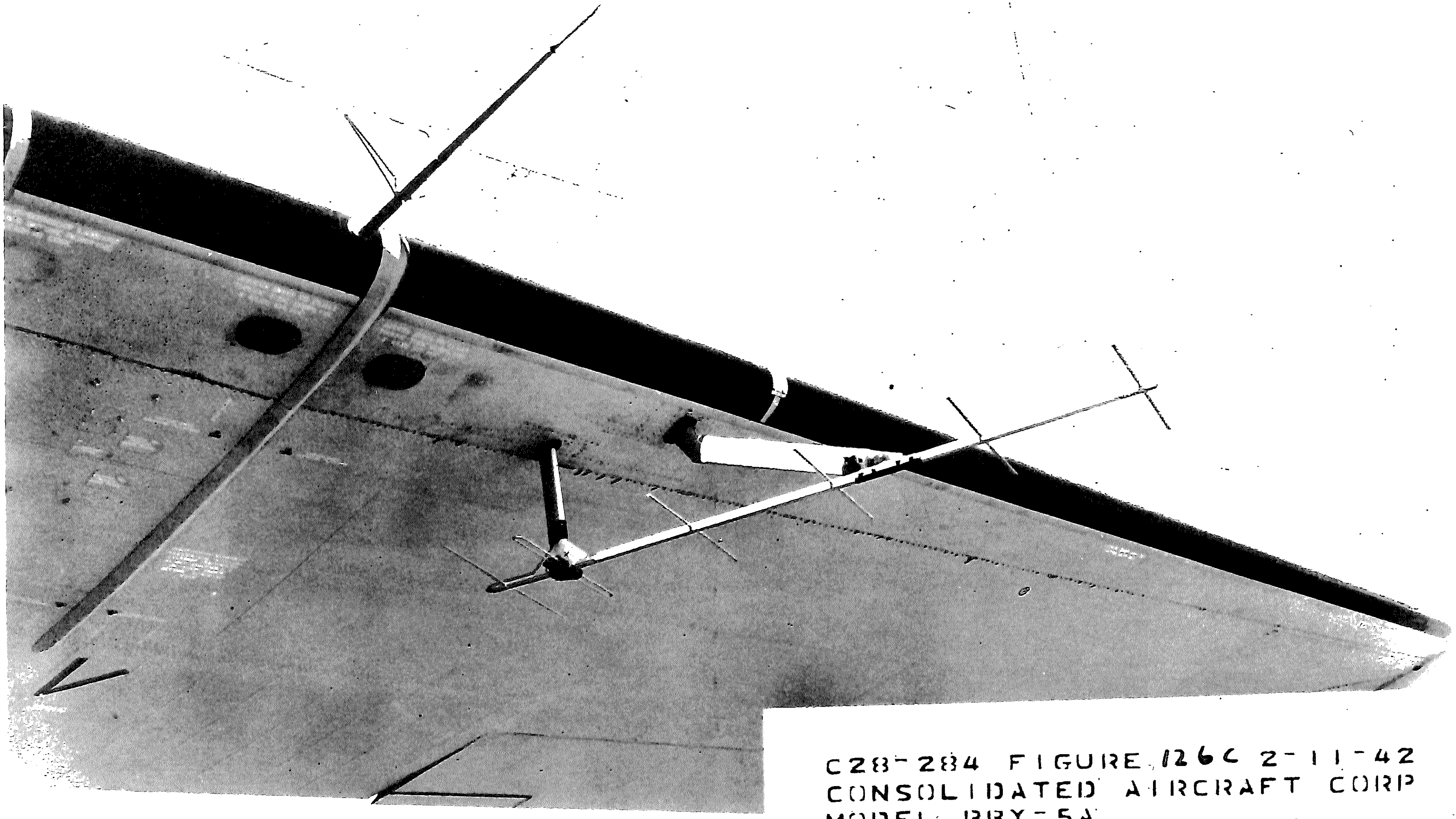
The wing tip floats must be lowered to install the wing tip antenna masts. The nut should be drawn tight on the stud attaching the lower end of the mast before tightening the screw in the clamp. Through hand hole in rib, check to see that the



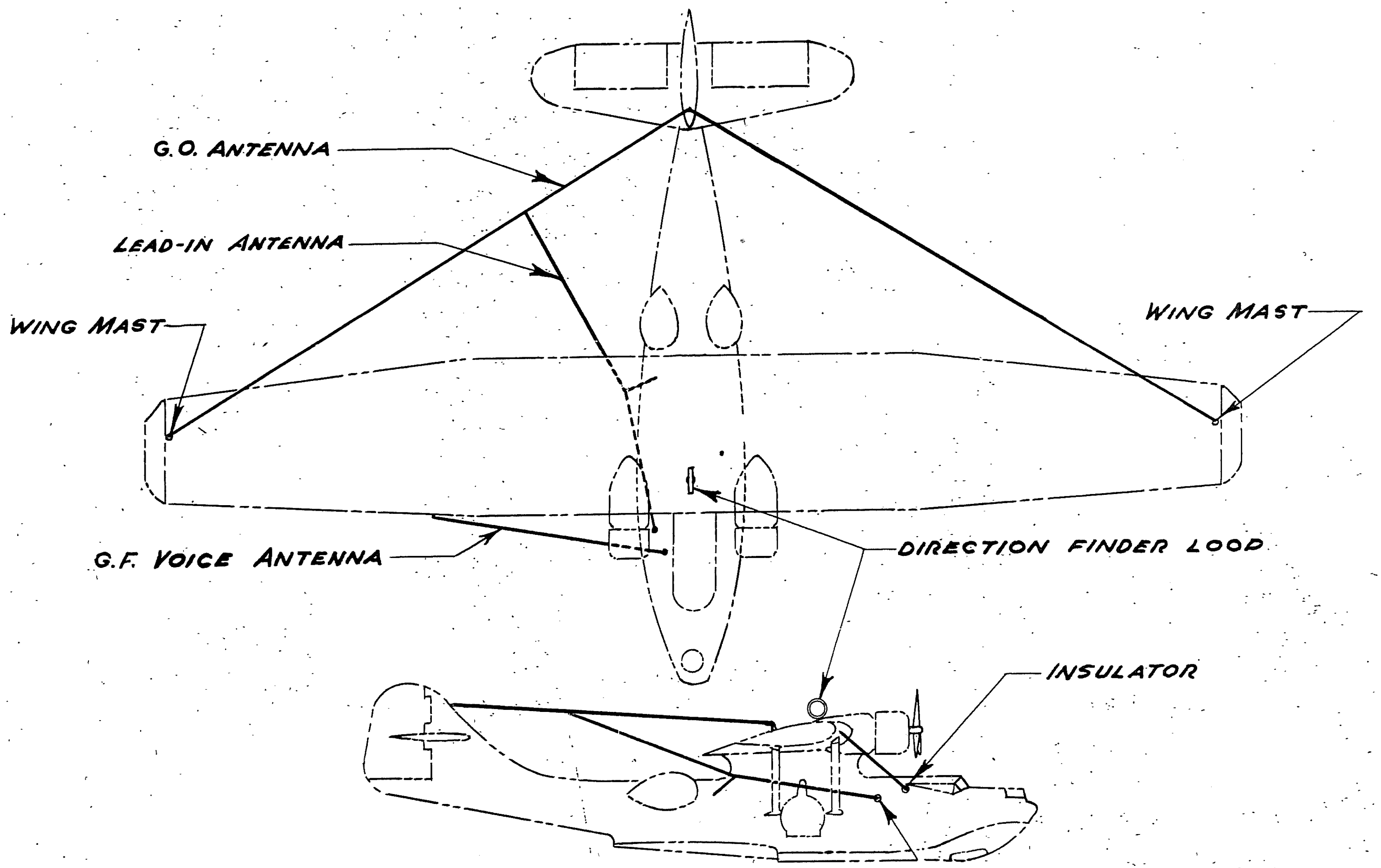
C28-287 FIGURE 126A 2-11-42
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A
YAGI TRANSMITTING AND
BROADSIDE RECEIVING ARRAYS
NEW INSTALLATION G. E. ANTENNA--PORT AND STARBOARD
SIDES.



C28-283 FIGURE 126B 2-11-42
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A
HOMING TRANSMITTING AND
RECEIVING ARRAYS--
STARBOARD WING - OUTER
PANEL.

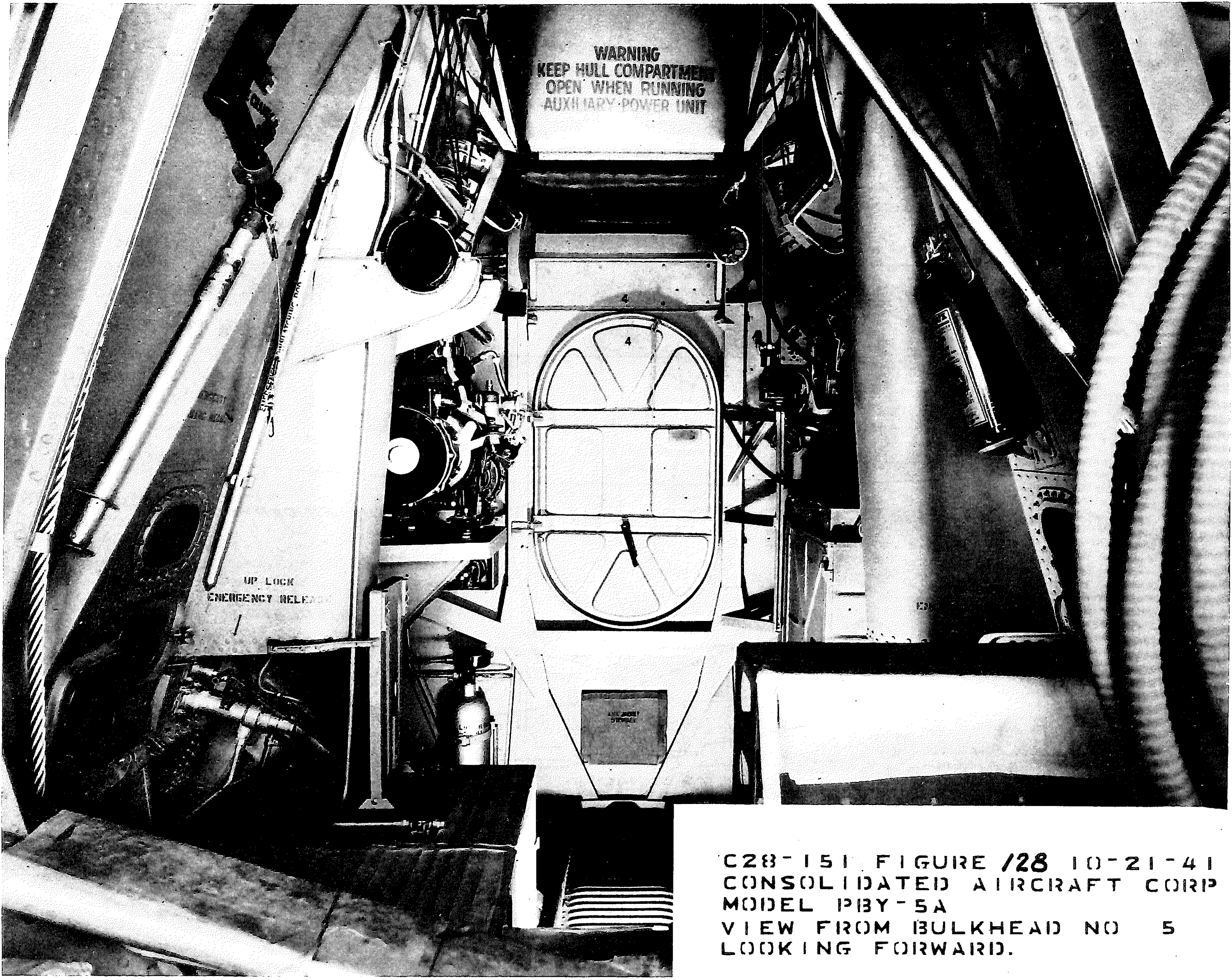


C28-284 FIGURE 1266 2-11-42
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A
HOMING RECEIVER ANTENNA
ARRAY AND ZA ANTENNA--PORT
OUTER PANEL.



REFER TO C.A.C. DWG. 28U5004

FIGURE 127
ANTENNA DIAGRAM



C28-151 FIGURE /28 10-21-41
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5A
VIEW FROM BULKHEAD NO 5
LOOKING FORWARD.

sleeve nut is properly seated when tightening the clamp.

NOTE: Transmission Lines.
Any exposed line ends must be mechanically protected with tape wrappings and sealed with liquid polystyrene to prevent moisture entering into cable. All transmission lines are extremely delicate and must be handled with caution. Do not bend in anything smaller than a 10" radius.

## 5. ASV - Radar Installation

Where no provisions are made for the Radar Installation, refer to C.A.C. Dwgs. 28W6029 L/R, 28W5517 L/R, 28W169-100, and 28W169-101 for directions for installation. If no parts are supplied, reference to 28W6011 will be necessary to fabricate parts called for on 28W5517.

On airplanes where provisions are already made in the wing for the Radar antenna, refer to C.A.C. Dwgs. 28W6029 L/R and 28W6011 L/R, for installation instructions.

On airplanes #02948 and #02977 inclusive, and #04399 to #04420 inclusive, holes are drilled at installation through both wing structure and strut at the same time. On airplanes #08030 to #08123 inclusive, holes in both leading edge structure and struts are drilled for interchangeability. All units for 52 above numbered ships will have serial numbers stencilled on the loose parts (28W6029).

Airplanes delivered without Radar antennae installed have the required structural reinforcements already incorporated in the hull and it is necessary only to install the attaching fittings on the outside of the hull in accordance with C.A.C. Dwgs. 28B5037, 28B5038, 28B5041 and 28B5045.

The Radar Installation consists of the following:

a. A Transmitter (aft bulkhead #2 starboard) and control panel (forward station #3 starboard).

b. A receiver mounted under radio man's confidential locker, forward of bulkhead #4 starboard side.

c. One visual indicator, mounted aft end of radioman's shelf.

d. Two antenna change over switches attached to stringers starboard - forward of bulkhead #3.

e. Two broadside receiver array matching units mounted to stringers on the port and starboard sides of the hull at approximately station #2.5

f. A broadside transmitting junction box unit supported on the stringers at the top of the hull, slightly to the starboard side just forward of station #3.

g. Two homing receiver array matching units attached to the wing outer panel leading edges immediately outboard of the outer panel wing splice.

h. Antenna arrays consisting of the following:

(1) Two homing receiver arrays symmetrically located on each wing between station #12 and #13.

(2) One homing transmitter array between station #19 and #20 on the starboard outer panel.

(3) Two broadside receiving arrays located on either side of the hull between stations #1.66 and #3.

(4) Two Yagi broadside transmitting arrays symmetrically attached to each side of the hull at station #3.

Maintenance consists of the following:

(a) Remove cover plates over cable terminal connections on wing and hull antenna arrays and check for loose connections.

(b) Check all bonding, hull attachment fittings and fairings for corrosion at each 100-hour check. Coat with 60% beeswax and 40% paralketone as a protective measure.

## 6. ZA Instrument Landing Equipment

Government furnished ZA instrument landing equipment is a blind instrument landing device. The component parts are located as follows:

Two indicators are located on the instrument panel in the pilot's compartment.

Control Unit is located on the co-pilot's right hand side.

Signal Localizer Receiver is located on the food locker just aft of bulkhead #2.

Junction Box is located on the aft side of bulkhead #2.

Glide Path Receiver is installed just forward of bulkhead #3 and above the G.O. transmitter.

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Impedance Adaptor Control is installed adjacent to the R.U. receiver switch boxes at the radio operator's table.

Antenna is located on the pitot static mast.

Refer to Figure 127.

## 7. A.F.C. Equipment

The following is the recommended procedure for setting initial cable tension of A.F.C. Equipment rudder cables.

a. Set tension on cable to 90 lbs.

b. Over power rudder servo motor while engaged.

c. Obtain tension meter reading on rudder cable.

d. Reset to 90 lbs. if drip on tension is greater than 10 lbs.

e. Repeat b.c.d. at least once and continue until at least 80 lbs. tension can be maintained on cable.

f. Check turn buckle to see if further adjustment is possible.

g. If condition e and f are not met, replace cable or sheaves of run-around to satisfy them.

This procedure will tighten the rudder run-around cables to a tension of approximately 180 lbs. thereby increasing bombing performance by removing any objectionable slack.

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## F. Navigating Equipment

### 1. General

The navigator's equipment described in this part is carried as useful load. Provision has been made for the stowage and use of each item.

### 2. Pelorus-Drift Sights (Ref. C.A.C. Drawings 28F1091 and 28F3084)

#### a. Description

Brackets for mounting a Pelorus drift sight are provided at four locations in the airplane. One pelorus mounting base is permanently bolted to each bracket. The pelorus sight is inserted into this by placing the bearing collar into the base.

One bracket is stowed on the starboard side of the bow cockpit. When used, it is fastened to the revolving circular windshield (with the windshield in the gun-stowed attitude) by means of the four Dzus fasteners provided. Care should be exercised in turning the windshield fully to starboard against the stops, in order to obtain the true fore and aft position for the sight.

At the front upper corners of the sliding window openings of the pilot's cockpit enclosure, provision is made for mounting pelorus bases.

A cast bracket is provided for use at the tunnel opening in the hull near beltframe #7.75. This bracket has two hook-like projections which seat into holes provided on top of the tunnel gun base. The bracket is then locked in place by turning the same knob and screw that locks the gun mount in the firing position. This bracket is stowed on the starboard side of the hull by means of a strap when not in use and is equipped with a safety chain.

The navigator should secure himself with the gunner's safety belt and extension provided at this station, prior to opening the gun hatch for sighting.

#### b. Operation

The bases are mounted on the cockpit support assemblies as follows:

(1) Position the support, with pelorus base attached and facing downward, so that notch in the support plate straddles

top former and side gusset of cockpit enclosure frame. (The small angle on the bottom of the plate should rest on the bushing which is located at the enclosure structure and is held by one of the structural bolts).

(2). Slide pelorus support along bushing until base is level athwartships.

(3). Tighten clamp on top of support plate to bulb section along top former of enclosure frame. (Tightening of the clamp is accomplished by turning the wing nut on the clamp.).

(4). After leveling pelorus in a fore and aft position, slide adjustable angle, located on top side of support plate, outboard until upper edge of leg comes in contact with gusset on top of enclosure.

(5). Tighten screws in angle.

(6). Turn thumbscrew on bottom of plate so that it contacts drain trough to rear of top former. This establishes rigidity in the installation.

(7). Oversize holes are provided in the support plate so that the pelorus base may be shifted slightly to true its zero axis of graduations with the fore and aft axis of the airplane.

### c. Stowage

The cockpit pelorus and supports are stowed, one on each side of the compartment, on the forward face of bulkhead #2.0 just outboard of the seats. Each pouch contains two pockets, one for the pelorus and one for the support and base.

The tunnel bracket is strapped to the starboard side of the hull when not in use.

Stowage for the bow and tunnel pelorus drift sight is accomplished by use of a loop and two spring clips provided on the deck stringers on the port side of the airplane between beltframe #3.33 and beltframe #3.66 just aft of the navigator's table. The pelorus shaft is inserted in the loop and the clips fit around the sight tube holding it in place.

### 3. Binoculars (Ref. C.A.C. Drawing 28F4007)

The navigator's binoculars are stowed in the navigator's locker located between beltframes #3.33 and #3.66 on the port side of the airplane.

### 4. Miscellaneous Charts

A chart and map drawer is installed on the under side of the navigator's table.

5. Chart Board

A chart board is stowed under the pilot's seat.

6. Protractor

The aircraft protractor is stowed on the port side of the hull between bulkheads #3 and #4.

7. Books

Books are stowed in the navigator's book case located on the forward face, port side of bulkhead #4.

8. Drift Sight

Provision for mounting a drift sight, for the navigator's use, has been made. The sight mount is located on the navigator's table on the port side of the hull. The mount consists of two brackets each equipped with three rubber tired rollers. One bracket is attached to the side of the hull just aft of beltframe #3.66 the other bracket is mounted on the navigator's table.

There is an opening provided in the hull through which the navigator operates the drift sight. See Figure 21 , for drift sight hull opening.

When the drift sight is not in use the hull opening is closed by a circular cover. The cover is held by three brackets under a notched stringer, attached to the cover. The cover is locked in place by rotating until the notches engage the hold-down brackets. The hull opening is provided with a neoprene gasket cemented in place around the hole.

To operate the drift sight, the hull cover is first removed as described above. The drift sight can then be rolled outboard on the rollers so that it projects through the hull opening.

The drift sight is stowed on top of the navigator's locker where it rests in two saddle brackets. It is held down by two straps.

9. Octant and Cover

Octant with case is stowed in the navigator's locker located on the port side just aft of beltframe #3.33.

10. Navigator's Watches

Provision is made for two navigator's watches which are kept in the watch drawer of the navigator's table.

## G. Miscellaneous Useful Load

### 1. Oxygen Equipment (Ref. C.A.C. Drawing 28F5200)

The oxygen equipment consists of 6 - 514 cu. in. oxygen cylinders, with mounting brackets, 14 stowage brackets for rebreather units, check valve outlets, manifold and pipe are provided.

> CAUTION: The following information is taken from Army and Navy Specifications and should be strictly adhered to for the prevention of accidents.
>
> Extreme care should be exercised in keeping the oxygen supply free of foreign particles.
>
> Use no oil, white lead, or other easily oxidized material in or about any part of the regulator, lines, or cylinders. The slightest amount of oil in the oxygen is a possible cause for an explosion. The small motion of the few working parts necessitates no oil or lubrication.
>
> Any cylinder containing gas under pressure is dangerous, and must be handled carefully. The correct pressure of oxygen for high altitude flying is 1800# per square inch. Cylinders shall not be handled by cranes, except when handled in a suitably constructed cradle or container. They shall never be handled by a magnet, a rope, or by cable slings. Oxygen cylinders shall never be dropped or handled roughly, and shall never be set on end, unless secured so as to prevent them from falling over or being accidently upset.
>
> Oxygen cylinders shall not be left near heaters, stoves, radiators, furnaces, or other sources of heat, and shall not be exposed unnecessarily to the direct rays of the sun, as an increase in the temperature of the gas will cause a corresponding increase in the pressure within the cylinder.

### 2. Engine and Airplane Tool Kit

The special tool kit is stowed in the tool compartment of the Tool and Miscellaneous gear locker.

An engine tool kit containing special tools for the airplane and engine is stowed in the aft position of the tool and gear locker.

### 3. First Aid Kit (Ref. C.A.C. Drawing 28F1518-20)

Stowage is provided for a first aid kit on the forward face of bulkhead #6, port side. A strap with the stenciled marking "First Aid" holds it in place.

4. Food and Water

Fourteen days food (140 lbs.) for seven men may be stowed in the two food lockers. One is located on the starboard side and the other on the port side, both aft of station #4. Emergency food, included in the 140 pounds, is stowed in the forward food locker.

Water is kept in four tanks of 4-1/2 gallons capacity each. The total amount of water carried is 140 lbs. (18 gals.)

5. Flashlights

Two flashlights with spare batteries are stowed in the gear and tool locker in the aft compartment.

A flashlight is also located at each of the four gun stations.

6. Canvas Bucket

One canvas bucket is carried in the miscellaneous gear locker.

7. Life Raft and Life Jackets

A Mark VII, seven-man life raft is stowed forward of bulkhead #7 on the starboard side of the airplane. It is secured by two straps with the stenciled marking "Life Raft."

Seven life jackets are stowed in bags throughout the airplane, convenient to each crew member.

8. Rope

Two lengths of 1-1/2" manilla rope, each 150 feet long, are stowed in the tool locker.

9. Buoy Hook and Rope (Ref. C.A.C. Dwg. 28F4160)

One Buoy hook is stowed on the starboard side between stations #0.33 and #0.66.

10. Boat Hook (Ref. C.A.C. Dwg. 28F4144)

An eight foot boat hook is stowed on the forward face of bulkhead #6 beneath the door.

11. Spotlight Case

Provision is made for the installation of a spotlight case on the forward side of beltframe #1.33 just to the right of centerline of the airplane.

The spotlight base is mounted on the port side of the bow gunner's turret.

12. Auxiliary Power Unit Fuel

Fuel for the auxiliary power unit is taken from the main fuel supply.

13. Parachutes (7) (Ref. C.A.C. Dwg. 28F1597)

Seven parachutes are stowed around the ship on bulkhead webs in positions accessible to the crew members. Each is secured in position by a fabric panel with an elastic cord in the upper end which hangs from a hook. The lower end is riveted to the structure. Each fabric panel is stenciled "Parachute."

14. Signal Flags (Ref. C.A.C. Dwg. 28F1478)

One set of semaphore flags is stowed on the starboard side, aft face of bulkhead #3 in the radio compartment.

15. Sea Anchor (Ref. C.A.C. Dwg. 28F6053)

The sea anchor is stowed in a bag located on the starboard side on the forward face of bulkhead #6 in airplanes #7243 to #7302 inclusive and #04972 to #05045 inclusive on contract #77713.

Stowage is provided on the portside on the forward face of bulkhead #7 in airplanes #2456 to #2488 inclusive on contract #70496 and in airplanes #02948 to #04420 inclusive and #08030 to #08123 inclusive on contract #88476.

16. Fog Horn

An electrically operated fog horn is mounted beneath the flight engineer's port window in the superstructure.

The button for operating the horn is located on the pilot's instrument panel.

17. Maintenance Manual Stowage

A pocket located on the forward face of bulkhead #5 provides stowage for the maintenance manual.

18. Blind Flying Curtain

For practice blind flying, a curtain is provided, which may be fitted to the portside of the pilot's enclosure, leaving only the instruments and controls uncovered and accessible. Stowage for the curtain is provided on the portside of bulkhead #2.

19. Windshield Spray

These airplanes are equipped with windshield sprays located at the lower center section of the pilot's windshield. The spray is operated by a hand pump mounted on a separate panel on the starboard side at the end of the pilot's instrument panel. When filling the tank, use pure methyl alcohol.

CAUTION: Do not mix glycerine with alcohol. A mixture of alcohol and glycerine produces a yellow film on the windshield which reduces vision.

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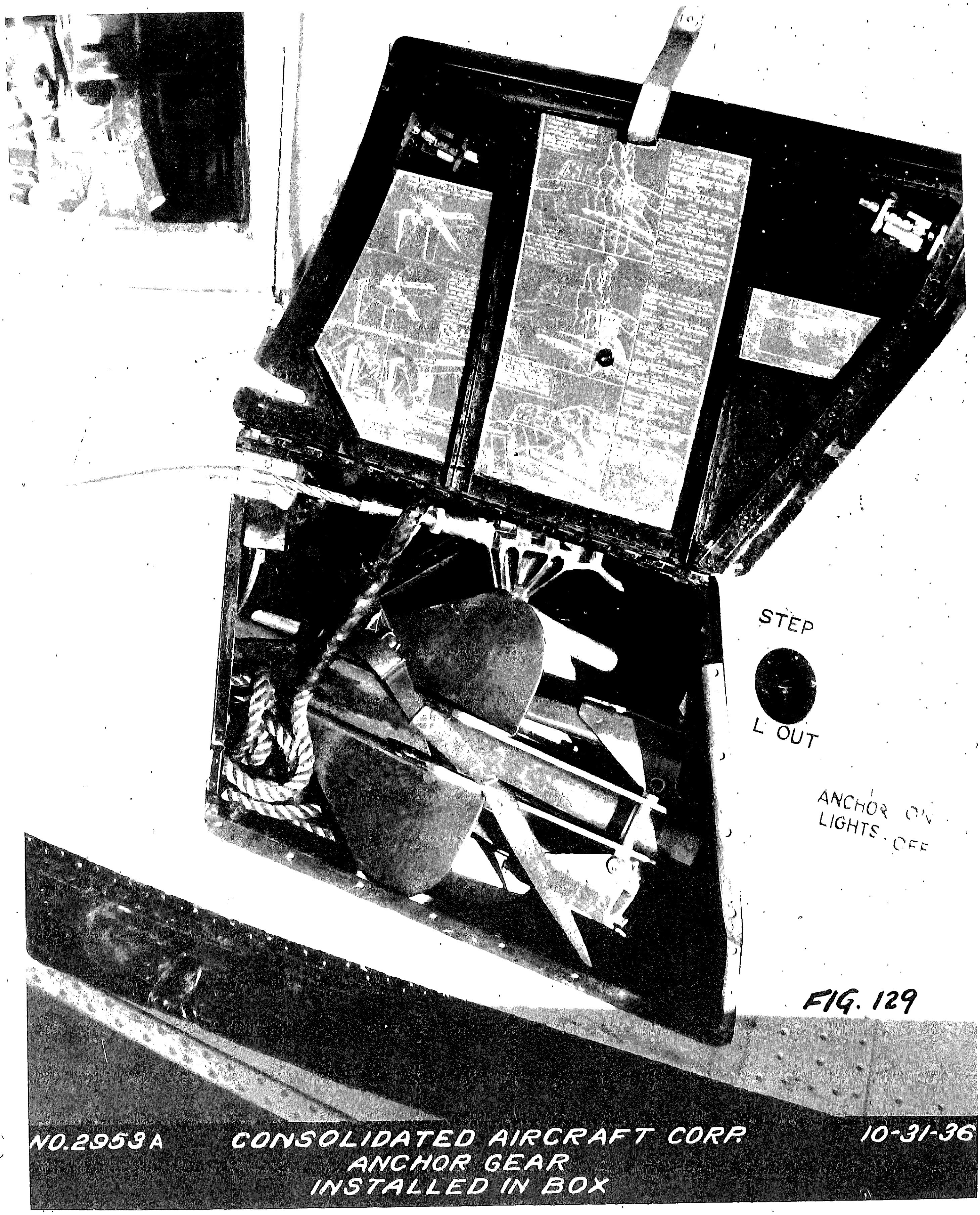
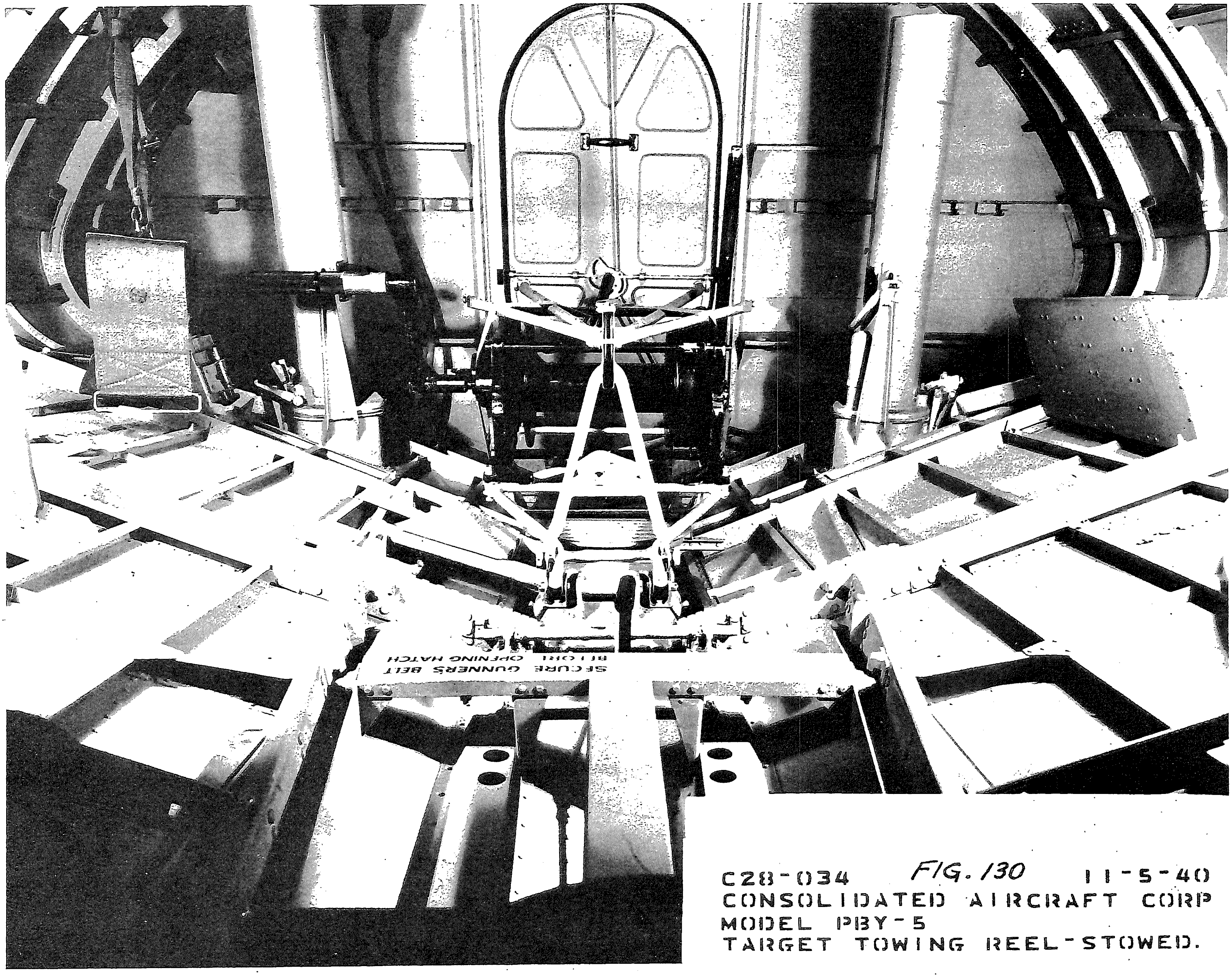
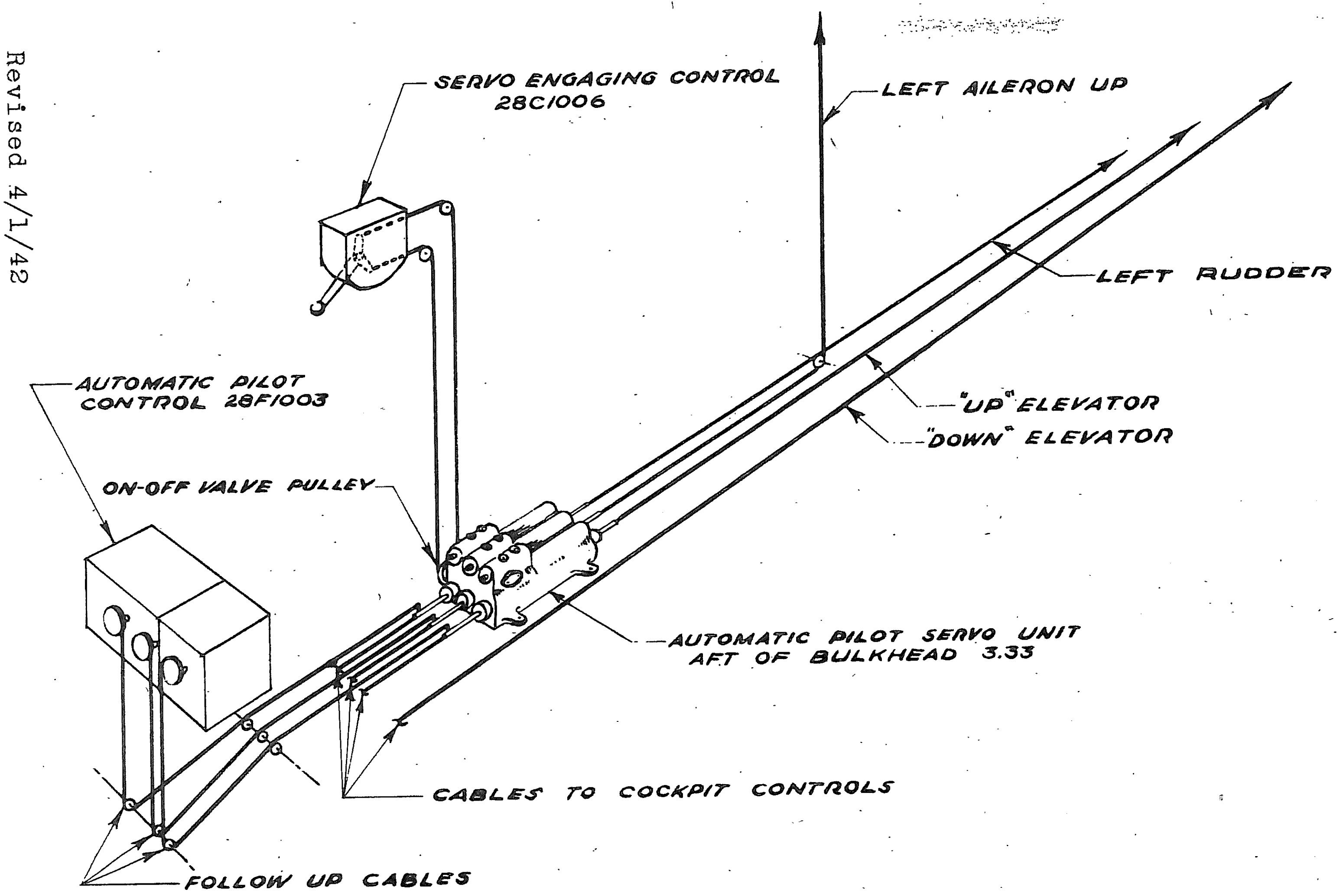


FIG. 129

NO.2953A CONSOLIDATED AIRCRAFT CORP. 10-31-36
ANCHOR GEAR
INSTALLED IN BOX



C28-034 *FIG. 130* 11-5-40
CONSOLIDATED AIRCRAFT CORP
MODEL PBY-5
TARGET TOWING REEL-STOWED.



REFER TO C.A.C. DWG. 28C5001

FIGURE 131
AUTOMATIC PILOT CONTROL SYSTEM

M.R.H.
28-5ME
28-5MC

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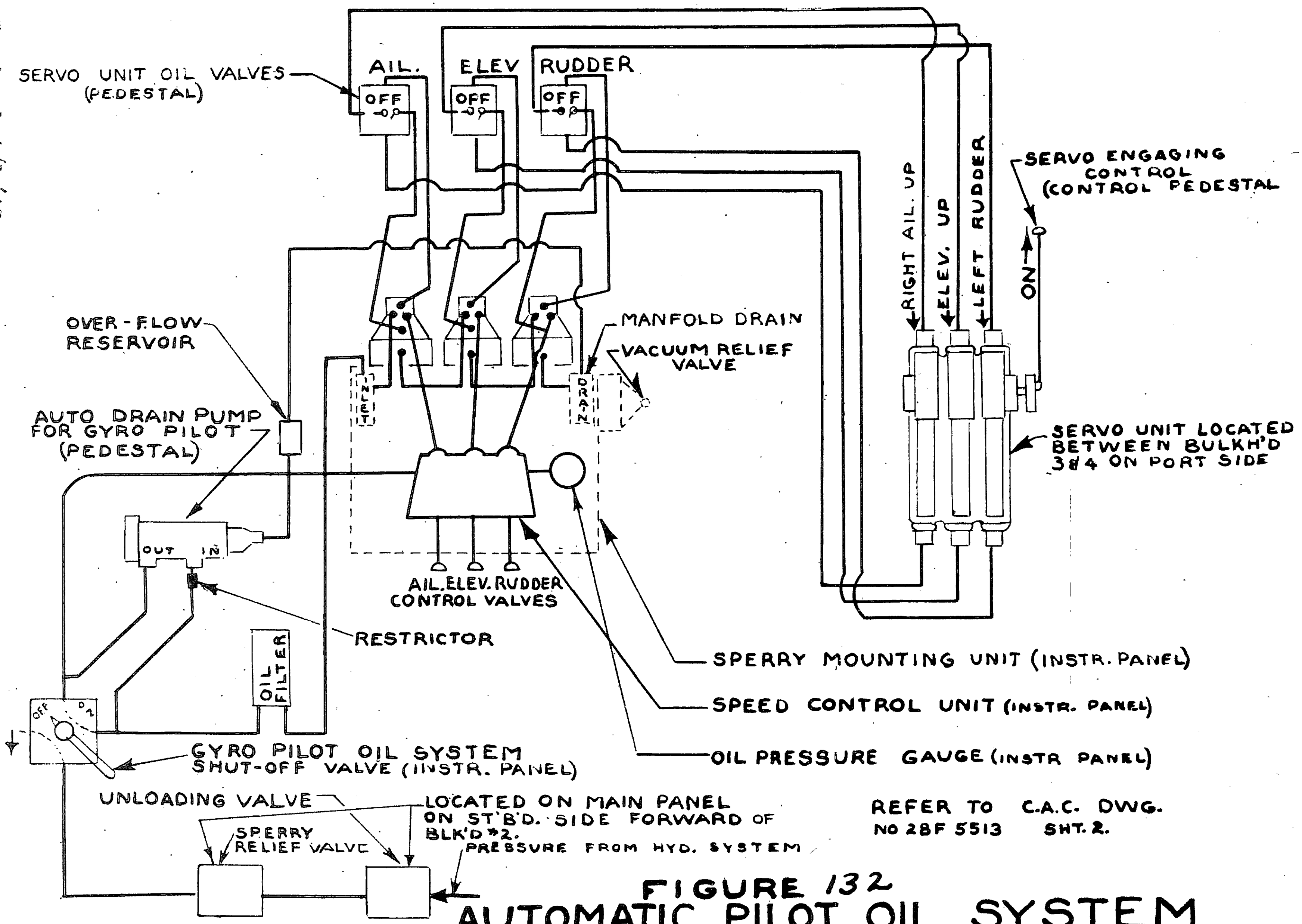
C.A.C.


SERVO UNIT OIL VALVES (PEDESTAL)
AIL.
ELEV
RUDDER
OFF
OFF
OFF
OVER-FLOW RESERVOIR
AUTO DRAIN PUMP FOR GYRO PILOT (PEDESTAL)
OUT
IN
RESTRICTOR
OIL FILTER
OFF
ON
GYRO PILOT OIL SYSTEM SHUT-OFF VALVE (INSTR. PANEL)
UNLOADING VALVE
SPERRY RELIEF VALVE
LOCATED ON MAIN PANEL ON ST'B'D. SIDE FORWARD OF BLK'D #2.
PRESSURE FROM HYD. SYSTEM
INLET
DRAIN
MANFOLD DRAIN
VACUUM RELIEF VALVE
AIL. ELEV. RUDDER CONTROL VALVES
SPERRY MOUNTING UNIT (INSTR. PANEL)
SPEED CONTROL UNIT (INSTR. PANEL)
OIL PRESSURE GAUGE (INSTR PANEL)
RIGHT AIL. UP
ELEV. UP
LEFT RUDDER
ON
SERVO ENGAGING CONTROL (CONTROL PEDESTAL
SERVO UNIT LOCATED BETWEEN BULKH'D 3&4 ON PORT SIDE

REFER TO C.A.C. DWG.
NO 28F 5513 SHT. 2.

FIGURE 132
AUTOMATIC PILOT OIL SYSTEM

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C.A.C.

# SECTION VI

# LUBRICATION AND INSPECTION

## A. Introduction

A complete routine for lubrication and inspection is given in this section. The information given here includes: The frequency of lubrication and inspection, the parts to be serviced, the number of points to be greased and the kind of oil or grease to be used.

The Commercial lubricants referred to in the following data are the products of the Socony Vacuum Oil Company, Inc.

## B. 30-Hour Check

### 1. Inspection

#### a. Propellers

Check the propeller control cables where they are close to the engine cowling for undue rubbing or wear.

Check propellers for nicks, dents and oil film.

Inspect hubs, attaching parts, lock pin, anti-icer ring, feed tubes, governor, switch and oil line.

Check propeller control throw for freedom of movement.

#### b. Engine Cowling

Remove and inspect for wear, cracks and loose rivets.

Check flap control throw.

Inspect intake manifolds.

Inspect exhaust collector ring. Check clamps for tightness.

#### c. Engine Bearers

Inspect engine mount for cracks, distortion, etc.

Inspect engine hold-down bolts.

Inspect cylinder hold-down bolts.

#### d. Fuel System

Check the anti-corrosion capsules on top of the fuel strainers in the main tanks, and replace the crystals if they are exhausted.

d. Fuel System - continued

Inspect and check the integral fuel tanks for corrosion. Inspect and check self-sealing fuel cells and interconnecting piping for pinching, chafing, sharp bends, etc.

Inspect all fuel lines for leaks, chafing and security of mount clamps and bonding.

Check control valves for tightness and proper functioning. Operate and check selector valve and cross feed valve.

Inspect priming lines for leaks, sharp bends and chafing.

Check hand fuel pumps for proper functioning and pressure.

Check flow meter by-pass valve.

Operate and check auxiliary power unit feed.

Inspect intake manifolds for leaks and defective gaskets.

Inspect vent hole in sylphon relief valve cover (use wire smaller than #80 to insure hole is open). (Fuel Pump). Clean screen and dry thoroughly.

Inspect fuel pump outlet connections.

Clean hand fuel pump strainer.

Inspect tank vents and fuel pump vents.

Check fuel quantity gages.

Drain small amount of fuel through sump: Inspect for foreign matter.

Remove and clean all screens, strainers and sumps. Inspect for water.

Inspect dump valves and all lines and hose connections for foreign matter.

e. Oil System Inspection

Check the oil cooler by-pass valve for proper operation (See Section IV, Part 4)

Inspect the tank for leaks, security of mountings, tightness and condition of hose connections.

### e. Oil System Inspection - continued

Inspect the oil cooler air ducts. See that they are all unobstructed, that the joints are tight and the cooler cores open.

Check the thermostatic oil cooler by-pass at the bottom of the oil tank for proper operation.

Inspect caps and the cap vents to the tanks.

Clean the strainer. If there is any excessive sediment, notify the engineering officer.

Inspect the oil system and hose connections for leaks.

Remove and check sump plugs for foreign matter and tightness.

Clean pressure strainer and inspect for sediment and metal.

### f. Electrical and Ignition

Check the float motor and controls as given in Section IV, Part E.

Inspect ignition wiring, ignition cannon plug and rubber couplings.

Check ferrules, nuts on shielding for tightness, and clamps for security.

### g. Wings

Inspect trailing sections of wings for damage or looseness of fabric, buckled ribs, attachment screws.

See that aileron hinges are free from dirt and show no signs of excessive wear.

Inspect the float retracting mechanism for correct operation.

Inspect the float latch for easy functioning of the unit at the tip of the wing. This may be done by working the pawl by hand against the spring.

Clean out the drain pipes from the float wells, two in each float.

See Section IV, Part "X", for De-Icer Inspection.

For information regarding the prevention of deterioration of fabric covered wings, refer to Navy Technical Note No. 8-4, of February 18, 1941.

h. Tail

Inspect tail surfaces for torn or loose fabric, hinges, attachment screws, etc.

Inspect the rudder and elevator tabs for proper functioning of the screw.

i. Wing Floats

Check all joints and connections throughout the system for evidence of wear and loose connections. Lubricate the float retracting screw oiler.

j. Landing Gear

Check the general condition of the welds. Check for bent tubes and permanent "set" in the axles.

Check hydraulic system for leaks.

Check the snap action sequence valve located on the starboard side of the wheel well to make sure that the valve snaps at the last 1/16" of travel of the nose wheel torque arm.

Inspect the sequence valves located aft of bulkhead #2 to make sure that the valve plunger completely bottoms when coming in contact with the nose wheel door torque tube bellcrank. Care should be taken to insure that adjustment of the valve is not made too long, thus causing the sequence valve bracket to deflect when the valve is operated by the bellcrank.

k. Brakes

Check the brakes as outlined in the instruction handbook furnished with the airplane.

l. Hull

Thoroughly clean the bow revolving circular windshield track, the revolving outer tear drop turret tracks, all gun tracks and torpedo director carriage track.

Blow out or clean in an approved manner all drain tubes located as follows: one in the anchor box, one on each side of the pilot's enclosure, draining window wells, one in the snubbing post well, and one in each of the rear gun mounts draining the gun ring.

m. Controls

Check the throttle cables, in and near the throttle warning switch at beltframe #3.66. Inspect the cables at this point for undue wear and fraying.

Inspect the aileron chain in the control yoke for security of all cotter pins at the connection of the cable terminal &

chain. (Access to the upper chain connections, in the cross tube above the yoke, is gained through the inspection plate on the forward side of the wheel sprocket housing). The lower chain connections, in the main cross yoke, are accessible through the inspection door on the yoke. Also see Section IV, Part "L".

### n. Instruments

Inspect the pilot's, bomber's and navigator's panel shock mountings for deep cracks in the rubber and for separation of the rubber from the metal parts. If either condition exists, replace the mountings. Also see Section IV, Part "Y".

### o. Oil Tank

At the first 30-hour inspection after the airplane is delivered, tighten all bolts which attach to oil tank to the nacelle structure.

### p. Armament

For servicing and inspection, refer to Section V, Part "C".

### q. Engine Accessories

Inspect manual starter pull and linkage.

Check starter, tachometer, generator for security.

Check magnetos, ground wire for security.

Inspect auxiliary power unit and service according to manufacturer's instructions.

Inspect lines, all connections to rear of firewall.

2. Lubrication

a. Bomber's Window

Grease the bomber's window mechanism through 5 oil holes with Medium Oil, Navy Spec. 2190 or equivalent.

b. Bombsight Base

Lubricate the base in one place with Medium Oil, Navy Spec. 2190.

For lubrication of other bombing equipment, see Section V, Part "C".

c. Rudder Pedal Assembly

Press grease, Navy Spec. M-304, Grade A, (Gargoyle Mobilgrease No. 2, or equivalent) into 8 Zerk lubricators at pedals.

d. Landing Gear

Lubricate according to Figures

Coat rubbing surface of "down lock latch" with Mobilgrease No. 2 (or equivalent).

e. Tear Drop Rotating Shield

Lubricate all moving parts of the locking mechanism with Medium Oil, Navy Spec. 2190, or the equivalent.

f. Gun Mounts

Oil lightly all moving parts with Medium Oil, Navy Spec. 2190, or the equivalent.

g. Brakes

Lubricate according to brake instructions manual.

h. Revolving Circular Windshield (Bow)

Lubricate the lock bearing at one place with Medium Oil, Navy Spec. 2190, or the equivalent. Do not allow oil to get on clamp or track.

i. Cowl Flap Hinges

Lubricate all moving parts with Medium Oil, Navy Spec. 2190, or the equivalent.

j. Surface Controls

See Section IV, Part "L", for servicing control cables.

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### k. Wing

Lubricate recoil and lock mechanism of the float retracting mechanism in one place with instrument oil, A.C. Spec. 2-27, (Gargoyle transformer oil, BB, or the equivalent). The oil hole is accessible through a hand hole located on the top surface of the wing (See Figure ).

Lubricate the float retracting screw oilers in the upper surface of the wing with instrument oil, A.C. Spec. 2-27, (Gargoyle Transformer Oil, BB, or the equivalent). (See Figure ). Also see Section IV, Part "I" for lubrication of float mechanism.

### l. Surface Control System

Lubricate all universal joints with Medium Oil, Navy Spec. 2190, or the equivalent.

Lubricate all tab piano hinges with Light Medium Oil, Navy Spec. 2135, or the equivalent.

## C. 60-Hour Check

The following parts are to be checked at 60-hour inspection. These items are to be checked in addition to those included under the 30-hour inspection.

### 1. Inspection

#### a. Hull

Check main beaching gear struts for free drainage.

Check fluid in master brake cylinders on beaching gear. If fluid is low refill to proper level with Lockheed #5 brake fluid or the equivalent.

#### b. Engines

Check engines according to the Pratt & Whitney Instruction Book for the R-1830-92 or R-1830-82 engines.

Check tightness of engine hold-down bolts. (384 inch pounds)

#### c. Wings

Check aileron control tube for freedom of operation on bearings; control bellcranks for freedom of operation.

Inspect float latch for easy functioning.

Clean out drain pipes from wells in floats.

#### d. Fuel System

Check the operation of the dump valves for proper operation.

Inspect potassium dichromate crystals in the sump and replace if exhausted. The tank must be drained to do this.

#### e. Oil System

Check the oil tanks for security of mounting.

Check oil coolers for leaks, obstructions, tightness of connections. Change the oil.

#### f. Electrical System

Check the generators for loose connections, worn or binding brushes.

Check the compartment for evidences of leaks and general material condition.

g. Wing Floats

Check all joints and connections throughout the system for evidence of wear and loose connections.

Check the floats for evidence of leaks or damage.

h. Radio

Inspect radio units according to instruction books furnished with radio units.

Inspect last 20 feet of trailing antenna, and lead out tubes for grooves.

Check antenna relay.

i. Radio Direction Finder

Check loop coupling nut and mounting screws. See that all cable plugs are securely locked. Check bonding.

j. Landing Gear

Check the tires for evidence of wear or damage.

k. Wing De-Icer Equipment

Check the equipment according to the De-Icer Instruction Book.

l. Propeller Anti-Icer Equipment

Check the system for evidences of leaks. Check the tank fluid for evidence of foreign matter.

m. Ignition System

Inspect magneto breaker assembly.

Check spark plug points, terminals, conduits.

Replace bad spark plugs with new or reconditioned ones.

2. Lubrication

a. Bomber's Window Mechanism

Worm Gear - lubricate with Medium Grease, Navy Spec. M-304, Grade B, (Gargoyle Mobilgrease, No. 2) or equivalent.

b. Bow Gun Mount

Oil lightly all moving parts with Medium Oil, Navy Spec. 2190, or equivalent. Use medium oil in 6 oil holes.

c. Control Yoke

Access is through plate in rear of wheel box. Lubricate with Medium Grease, Navy Spec. M-304, Grade B, (Gargoyle Mobilgrease No. 2, or equivalent)

d. Tab Control Gear Boxes

Coat all gears thoroughly with Medium Grease, Navy Spec. M-304, Grade B, (Gargoyle Mobilgrease No. 2, or equivalent) in two places.

e. Pilot's Seat Adjusting Mechanism

Tilt Lever - Lubricate with Medium Oil, Navy Spec. 2190, or equivalent, in two places.

f. Watertight Doors

Lock Mechanism - Lubricate with Medium Oil, Navy Spec. 2190, or equivalent, in ten places.

g. Navigator's Hatch

Lock Mechanism - Lubricate with Medium Oil, Navy Spec. 2190, or equivalent, in five places.

h. Cowl Flap Operating Mechanism

Lubricate with Medium Grease, Navy Spec. M-304, Grade B, (Gargoyle Mobilgrease No. 2, or equivalent) in one place.

i. Preheater control

Worm Gear - Lubricate with Medium Grease, Navy Spec. M-304, Grade B, (Gargoyle Mobilgrease No. 2 or equivalent).

j. Hatch Locking Toggle

Press Grease, Navy Spec. M-304, (Gargoyle Mobilgrease No. 2, or equivalent) into 2 Zerk lubricators.

k. Tunnel Gun Mount

Use Medium Oil, Navy Spec. 2190, or equivalent, in two oil holes.

Oil lightly all moving parts with Medium Oil, Navy Spec. 2190, or equivalent.

l. Tunnel Gun Doors

Lock Mechanism - Use Medium Oil, Navy Spec. 2190, or equivalent, in five places.

l. Tunnel Doors - Continued

Tunnel Gun Door Hinge - Use Medium Oil, Navy Spec. 2190, or equivalent, in two places.

m. Rudder Flap Mechanism

Operating Screw - Lubricate with Heavy Rust Preventative Grease, Navy Spec. 14C4, Grade A, in one place.

n. Elevator Flap Mechanism

Operating Screws - Lubricate, Heavy Rust Preventative Grease, Navy Spec. 14C4, Grade A, or equivalent, in two places.

o. Aileron Tab Torque Tube Mechanism

Port Aileron Only - Coat all joints and bearings with Medium Grease, Navy Spec. M-304, Grade B, (Gargoyle Mobilgrease No. 2), or equivalent, in five places.

p. Anchor Door

Oil moving parts with light medium oil, Navy Spec. 2135, or equivalent.

q. Rudder Assemblies

Pulley Bracket Hinges - Oil with Medium Oil, Navy Spec. 2190, or equivalent.

Trip Levers - Oil with Medium Oil, Navy Spec. 2190, or equivalent.

r. Anchor Winch

Lubricate chain, worm and gear, clutch yoke, and helix shaft lightly with Medium Grease, Navy Spec. M-304, Grade B, (Gargoyle Mobilgrease No. 2), or equivalent.

Oil moving parts with Medium Oil, Navy Spec. 2190, or equivalent.

s. Sliding Glass

Treat pilot's sliding glass and hatch felts with glycerine.

t. Elevator and Rudder Tab Controls

Oil screws with instrument oil, A.C. Spec. 2-27, (Gargoyle Transformer Oil, BB), or equivalent.

u. Dump Valve Control

Oil moving parts with Medium Oil, Navy Spec. 2190, or equivalent.

v. Brake Mechanism

Oil moving parts with Medium Oil, Navy Spec. 2190, or equivalent.

w. Power Plant

(1). Preheater Control - Grease control with Medium Grease, Navy Spec. M-304, Grade B, (Gargoyle Mobilgrease No. 2), or equivalent.

(2). Magneto - Check magneto breaker oil wick felt for lubrication.

(3). Engine - Clean engine with pressure cleaner. Use mixture of 50% Kerosene and 50% crystal oil.

PRECAUTION: Do not use engine cleaner without first wrapping rags around propeller shaft just forward of nose section to keep Kerosene cleaning oil from forward thrust bearing.

x. Wing Floats

Lubricate the moving parts of the main gear box with Light Medium Oil, Navy Spec. 2135, or equivalent.

Grease the following with Medium Grease, Navy Spec. M-304, Grade B, (Gargoyle Mobilgrease No. 2), or equivalent: Trunnion Roller Track; Retracting Struts; Lock Spring at the Wing Tip.

Oil the float lock latch with Instrument Oil, Air Corps Spec. 2-27, (Gargoyle Transformer Oil, BB) or equivalent

y. Control System

Lubricate all control chains throughout the airplane chain lubricant, Federal Spec. VV-L-751, (Gargoyle Viscolite No. 10 or equivalent.

Oil all threaded joints and screw jacks with Instrument Oil, Air Corps Spec. 2-27, (Gargoyle Transformer Oil BB), or equivalent.

Clean and coat all control cables with Paralketone, R.M. 61, Type B or equivalent.

z. Wing De-Icer Equipment

Lubricate the pump assembly according to the manufacturer's instructions in the De-Icer Instruction Book supplied with the airplane.

aa. Anti-Icer Equipment

Lubricate the Pesco Pump according to manufacturer's instructions in the Instruction Book supplied with the airplane.

bb. Armament

(1). Side Waist Guns - Lubricate the gun mount assembly bearing with Light Medium Oil, Navy Spec. 2135, or equivalent.

(2). Tunnel Gun - Oil the gun mount assembly with Aircraft Instrument Oil, Air Corps Spec. 2-27, (Gargoyle Transformer Oil BB), or equivalent.

Oil the hull and gun floor hatch hinges with Light Medium Oil, Navy Spec. 2135, or equivalent. Oil the locking mechanism with Light Medium Oil, Navy Spec. 2135, or equivalent.

D. 120-Hour Check

1. Inspection

a. Power Plant

Check valve clearances. Check rocker arms for excess side play. Renew clamp-shell gaskets if required.

Inspect preheater. Check push rod housing for proper security.

Check generators. Pull if necessary.

Check magneto contact points for proper clearance. Tolerance .050 to .030.

Check magneto rubber coupling for wear and cleanliness.

Check starter for cracked flanges and security of mounting. Check linkage for wear and proper adjustment.

Inspect the pedestal mounts. Replace and tighten if necessary.

Check the engines and propellers according to the manufacturer's Instruction Books furnished with the airplane.

b. Fuel System

Check engine-driven fuel pump for security and oil leaks.

Drain gas tanks and clean the main gas tank strainers.

Inspect fuel tanks for security of baffles, rivets and cover plates.

Drain and clean fuel tanks.

Remove and clean strainers and test operation of fuel dump valves.

Inspect gas tanks for corrosion or evidence of leakage.

Inspect dump valve gland for leaks and dump valve wire pin and cables for rust.

c. Oil System

Check oil regulator for proper functioning and leaks. Check the oil pump for security and oil leaks.

Check the oil tanks for security and the oil tank securing bolts for corrosion, loose parts or damage. Replace the bolts, if necessary, with AN-3 steel bolts. Use aluminum washers to inhibit corrosions.

Check the oil temperature regulator for proper functioning and for leaks. Check the Pratt & Whitney sump drain plug, and the oil cooler.

Inspect the rubber hose and the clamps. Replace them when necessary.

d. Wings

Inspect wing tip floats for leaks, loose rivets and security of attachment.

Inspect fabric and repair as necessary. Inspect for buckled ribs.

Inspect fuel and oil tanks for security. Inspect oil tank securing bolts for corrosion, looseness or damage. Replace when necessary with AN3 steel bolts. Use aluminum washers to inhibit corrosion.

Drain gas tanks and clean main gas tank strainers and test dump valves.

Inspect gas tanks. Inspect dump valve gland for leaks, and dump valve cables and wire pin for rust.

d. Wings - continued

Inspect aileron hinge fittings for enlarged hinge bolt holes.

Inspect for water in floats and check condition of all exposed parts, particularly plate seams around strut ends. Check vents. Inspect safety wire on cap screw and forward handling lug for corrosion.

e. Tail

Clean and check bearings for cracks, abrasions and wear.

Clean and check attachment fittings of fins, rudders, and horizontal stabilizer unit to hull for firmness, corrosion, etc.

Inspect internal bracing of extreme after part of hull and stabilizer.

Remove grease from float struts, inspect and regrease.

Inspect all zipper pulls, clean heavy grease and paint off zippers.

Remove wax and grease from rudder and elevator tube sockets and lubricate.

Remove control tabs on rudder and elevators, inspect and lubricate.

Inspect attachment bolts, fittings of vertical and horizontal stabilizers.

Inspect rudder and elevator hinges and fittings.

f. Hull

Inspect hull exterior for loose rivets and buckling. Blow out and clean all external vents and ducts.

Inspect hull interior, checking the following: $CO_2$ engine fire extinguishers, handles, cables, lines to engine; All control cables, pulleys, fittings (turnbuckles, etc.); stowage of all accessories and equipment; flare tubes and doors for leaks; tunnel hatch for leaks and proper operations; $CO_2$ hand fire extinguishers for charge and ease of operation; drift sight tube for leaks, corrosion, condition of gaskets and security of tube cover; trailing antenna tube for leaks, corrosion, condition of gaskets and security of tube cover; flooring and walkways. Clean bilges and clean interior of hull thoroughly.

### g. Wheels and Brakes

Wheels - Remove the wheels; inspect wheel bearings and lubricate according to Section IV, Part K, 3, b.

Inspect wheels for cracks, distorted rim flanges and distorted ribs.

Inspect felt grease retainers. If grease-soaked, replace with new washers.

In order to prevent corrosion, wheels are furnished with a protective coating, Parts which have this coating chipped off, worn through, or removed in any manner should be recoated immediately to prevent corrosion. Except on friction and bearing surfaces, entire wheels should have this protective coating.

At no time should wheels which are corroded on the inside be used.

Brakes - Make a general inspection of the brakes without disassembling the brake unit. Inspect the entire assembly for corrosion and broken parts. Check the clearance between the brake discs and the adjusting nut. Blow out any dirt or foreign particles with air.

General - Check the system for leaks; check vent opening; check for air in the system.

### h. Controls

Inspect control cables for corrosion, broken strands and free running. Remove wax and grease and relubricate.

Check condition and tautness of all control cables and fittings; turnbuckles for safety wiring, and all fairleads for wear.

Inspect for corroded steel screws.

### i. Towing, Mooring and Anchor Gear

Overhaul all tackle; test strength of cable if doubtful.

### j. Instruments

Check vacuum pumps for security of mounting and oil leaks.

k. Equipment

Inspect life raft cylinder valve seal.

Inspect first aid kit for completeness.

Check anti-icer fluid tank and make ground test to check operation.

l. Dynamotor

Inspect brushes and holders.

m. General - Corrosion

Inspect the following:

All bulkheads - especially at bottom flanges and the small flange bulkhead on the after part of the tail around the tunnel hatch.

Rivet heads in bilges - especially after tunnel hatch.

Steel clevis guide or retaining pins in all control sheave brackets.

Anchor well and nose wheel well.

Wing tip float stops.

Anchor nuts on waist gun mount support bracket.

seams where trailing edge section joins main wing center section.

Antenna securing hooks.

Underwater hull and keel seams and rivets.

2. Lubrication

a. Anchor Winch

(1) Pulleys - (Access Outside Ship)

Lubricate in two places with Medium Oil, Navy Spec. 2190, or equivalent .

(2) Reel (Access Outside Ship)

Press Grease, Navy Spec. M-304, Grade A, or equivalent, into 1 Zerk lubricator.

(3) Reel - Access Inside Ship

Press grease, Navy Spec. M-304, Grade A, or

2. Lubrication - Continued

equivalent, into 2 Zerk lubricators.

b. Float Retracting Mechanism

(1) Upper Center Gear Box

Fill to 1/4" depth only with grease, Navy S pec. M-304, Grade A, orequivalent, in 1 place.

(2) Universal Joint

Lubricate in 1 place with Medium Oil, Navy Spec. 2190, or equivalent.

(3) Shaft Bearings

Lubricate in 3 places with Grease, Navy Spec. M-304, Grade A, or equivalent.

(4) Main Gear Box

Fill each of 2 sections to 1/2 inch depth only with Grease, Navy Spec. M-304, Grade A, or equivalent, in 2 places.

c. Flare Containers

(1) Release Mechanism

Press grease, Navy Spec. M-304, Grade A, or equivalent, into 2 Zerk lubricators on release rack.

d. Wing

(1) Torque Tube Guides, Bearings (Each Side)

Lubricate with grease, Navy Spec. M-304, Grade A, or equivalent.

(2) Terminal Gear Box

Access through handhole as shown on Figure. Fill to 1/4 inch depth with grease, Navy Spec. M-304, Grade A, or equivalent.

(3) Float Thrust Bearing

Pack with Medium Grease, Navy Spec. M-304, Grade B, (Gargoyle Mobilgrease, No. 2), or equivalent.

### (4) Float Control Gear Box

Access through handhole as shown on Figure . Fill to 1/4 inch depth with grease, Navy Spec. M-304, Grade A, or equivalent.

## E. 400-Hour Check

### 1. Dynamotors

Replace low voltage brushes at 1/4 inch length. Replace high voltage brushes at 5/16 inch length.

### 2. Wheels

Same as 100 hour check.

### 3. Brakes

After removing wheels, completely disassemble brake units and inspect all parts.

Inspect all discs for wear and replace if necessary. If discs are found to be dished in or warped, remove and flatten them by tapping them on a flat plate until they return to flat condition. If dished, tap on outer circumference; if warped, tap on inner circumference.

## F. General

For detailed information regarding lubrication for engine accessories, auxiliary power units and propellers, refer to Technical Note No. 22-41, dated June 12, 1941 (superseding T.N. No. 21-38).

## G. Pre-Flight Inspection

### 1. Preparation

a. Check for gas and oil.

b. Check all cowling.

c. Turn engines over six revolutions by hand.

d. Make sure there is a stand-by man in view, in front of the ship at all times.

e. Provide for a man with a bottle ($CO_2$) on the top wing.

f. Check and make sure landing gear is clear and all auxiliary locks are off.

g. Make sure hydraulic system has sufficient oil in supply tank.

h. Provide for interphone.

2. Engine Start

a. Start auxiliary power plant.

b. Mechanic to be provided in mechanic's seat.

c. An inspector must witness all readings on mechanic's instrument panel, also observe all the flow checks.

d. The cockpit will be occupied by a flight inspector.

e. An electrical man shall be available for all electrical check of panel and functioning of electrical equipment and adjustments.

3. Engine Run

a. Run engines at 800 to 900 RPM until oil temperature reaches 50°C.

b. Set all gyroscopic instruments to a 0° setting so as to be able to check creep during engine run.

c. While engines are warming, keep a visual view of man on the ground for landing gear check signals, as well as anything that may go wrong. Accomplish the float check at this time.

d. Check de-icer boot operation and sequence of boots by checking one wing against the other, having the same boots operating together on either side. Pressure reading at 800-900 RPM will be approximately 3.8 pounds. (Pressure gage reading should be 5.5 to 6 inches maximum at final run of 2400 RPM).

e. After engines have reached 50°C., increase RPM to 1150 and try propeller governors to see if they will operate when pulling levers back to high pitch on low RPM. This is to check the cut in point of the governor. One should have about a 50 RPM loss. At this same time check the throttle lever alignment as well as the propeller pitch levers and see that the center knuckle is well locked and no slippage is evident.

f. At 1275 RPM check the vacuum pump pressures on each engine which should be 4 inches. At the same time block off the regulator underneath the instrument panel by holding hand over same. Each engine on shifting the control selective handle should deliver about 4.5 inches. If one delivers more than the other, determine the engine and readjust vacuum pump at the engine accordingly, up to 4.5 with regulator back of instrument panel blanked off.

g. Bring the RPM up to 1500 RPM, try the ignition switches for proper functioning as well as any drop off. At this point the propellers should be thoroughly exercised to make sure the domes have a supply of warm oil and are functioning properly.

h. Bring RPM up to 1600 on both engines and have the electrician check the output of the generators with a load on and the load off. This should vary from 12 to 15 amperes.

i. Bring engine to 2000 RPM after this check and see that the magnetos are functioning properly and that manifold pressures and engine in general functions properly. At this same time, take readings on the mechanic's panel.

j. The cross feed and flow check will all be taken at the 1250 to 1500 RPM range by the mechanic and the inspector at the mechanic's panel.

k. After the 2000 RPM run, the 2400 RPM run or blast will follow immediately, flight mechanic and front inspector taking readings at the same time. Readings should correspond.

l. At this point, the cylinder heads should be in the range of 200°c to 210°c and idling should be checked immediately. See note at end for desired idling and functioning.

m. After idling and acceleration of throttle for proper carburetion is checked, the feathering of propellers will be accomplished.

n. Have the electrician set the generator switches off of proper bus bars. As reference bring the left engine up to 1250 and the right engine to 1500 RPM, so as to bring the generator in for propeller feathering power. Press the feathering switch on the left propeller, which should feather and kick out. After taking the RPM reading and manifold pressure, press the feathering switch in again and hold until the RPM returns to about a 1000 RPM, then release switch to see if it will return by itself. The same procedure will be for the right engine, reversing above action as used to feather the left propeller. The man accomplishing the above should be very alert and keep an eye on the engine at all times, so in the case of a feather line failure he can return the button at once, stopping the prop feathering motor, not lose all the oil and avoid a possible fire. The proper RPM when a propeller is feathered from 1250 RPM, will be approximately 570 to 590 RPM and approximately 24 inches manifold pressure.

o. After the above is accomplished and the head temperature is still about 200°C., the float warning light and warning horn should be checked. The above is not referred to in RPM, but in manifold pressure. When easing either throttle back, the light should come on at 15 inches manifold pressure. This is accomplished by one throttle being open and pulling back the opposite and vice versa.

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p. WARNING: Never get the cylinder head temperature over 232°C at any time.

q. The landing gear, after being checked for proper operation and signals in cockpit and clearances for wheel and nose well, should have safety chain on operating release lever re-installed.

The proper pressure as noted on gauge should be 1000 to 1050 pounds.

After stopping engines, recheck the supply tank for the proper amount of oil.

r. Always make sure navigator's hatch is closed and no men go out through it to top of wing during run.

Never put head out of top hatch at co-pilot and pilot's seat and wave arm during run.

Never leave the cockpit with the switches on.

Cooperate in every respect to help maintain safety for the personnel on stands around the propeller vicinity after and before run.

s. Desired operating pressures and temperatures which should be obtained:

Oil Temperature - 76° to 80°C.

Oil Pressure - 85 to 100 pounds at 2000 RPM.

Fuel Pressure - 14 to 16 pounds at 2000 RPM.

Wobble Pump Pressure at 60 smooth strokes per minute should be 15 pounds minimum and 18 pounds maximum.

Desired idling should be 600 RPM at 210° plus 12" to 14" manifold pressure, which, when cool will be 530 to 550 RPM at 15" manifold pressure.

t. Never operate throttles in a quick and abusive action.

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## SECTION VII

## MATERIAL OF CONSTRUCTION

The following is a list of the materials used for structural parts of the airplane. The chart includes the material specification and its physical properties, and the required heat treatment.

| Material | Specification | Heat Treat Specification | Ultimate Tensile Strength (Thousands of Pounds) | Yield Point in Tension (Thousands of Pounds) |
|---|---|---|---|---|
| Aluminum Alloy | | | | |
| Bar | 46A9 | SR-53 | 62 | 40 |
| Extruded Shapes | 46A9 | SR-53 | 57 | 42 |
| Sheet | 47A10 | SR-53 | 62 | 40 |
| Tubing | 44T28 & 44T21 | SR-53 | 62 | 42 |
| Castings | 46A1 Cl 4 | | 29 | 16 |
| Castings | M-186 | | 42 | |
| Castings | 46A1 Cl 3 | | 26 | 16 |
| Forgings | M-277 | | 65 | 50 |
| Bronze | | | | |
| Castings | 49B3c | | 65 | 30 |
| Lumen Alloy Castings | #20 | | 105 | 65 |
| Steel-Chrome Molyb. | | | | |
| Bar | 46S23 | SH-27 | 90 | |
| Forgings | 46S23 | SH-27 | 50 | |
| Sheet | 47S14a | SH-27 | 65 | 45 |
| Tubing | 44T18a | SH-27 | 90 | 70 |
| Stainless Steel | | | | |
| Bar | M-286B | | 175 | 135 |
| Bar | 46S18b GR.1-C | as purchased | 70 | 35 |
| Bar | 46S18b GR.7-E | as purchased | | |
| Castings | 46S27 | as purchased | 70 | 32 |
| Sheet | 47S19 | as purchased | 80 | 35 |
| | 47S21 | as purchased | 125-185 | 75-140 |
| Tube | 44T25 | as purchased | 80 | 30 |
| | 44T27 | as purchased | 80-135 | 35-140 |

# SECTION VIII

# FINISH SPECIFICATION

## A. GENERAL FINISH PLAN

The general finish plan shall consist of the application of 3 coats of organic finish on a prepared surface. Exceptions to the general plan are as follows:

1. Contacting surfaces
2. Surfaces forward of the firewall
3. Fuel tank interiors
4. Oil tank interiors
5. Tubing interiors
6. Conduit
7. Conduit boxes
8. Government furnished material
9. Cable
10. Plastics
11. Rubber and neoprene
12. Fabric surfaces
13. Corrosion-resistant steel parts
14. Bolts and standard parts

Finish requirements shall be noted on the Contractor's drawings in accordance with the requirements of paragraph 2.4 of SR-15c, except where deviations are necessary, due to the complexity of drawings.

## B. SURFACE PREPARATION

Surface preparation shall consist of cleaning, anodizing, plating, metal spraying, or chemical treatment as noted below. The application of the first organic finish coat where required, should follow the surface preparation with the minimum delay and minimum handling possible.

### 1. Cleaning

a. All parts shall be carefully cleaned immediately prior to anodizing or other inorganic surface treatment. A mild cleaner having free rinsing properties of established merit shall be used. Hot rinsing shall follow cleaning.

b. Parts subject to delay between surface preparation and the application of the priming coat (outside purchased parts are the main examples) shall be cleaned with a solvent cleaner to remove any grease, prior to applying the prime coat.

c. Parts which are handled or subjected to shop processing after the initial priming coat shall be cleaned with a solvent cleaner to remove all grease before applying subsequent finishing material. Care shall be taken to remove as little of the original priming coat as possible and to leave no residue of cleaning material.

d. Welded parts and castings may be wire brushed or sandblasted to remove scale or other tenacious foreign material.

2. Anodic Treatment

a. All aluminum alloy airplane parts shall be given anodic treatment except as follows:

(1) Electrical conduit
(2) Conduit fittings
(3) Electric switch and junction boxes including distribution panels
(4) Housings for connector receptacles
(5) Electric plug connections

b. All parts receiving anodic treatment shall be treated in detail except parts approved for spotwelding and items of furnishings meeting the following conditions:

(1) If the assembly is so situated in the structure as not to come in direct contact with salt water, or where the possibility is remote that salt water or spray will enter or remain due to lack of free drainage.

(2) If no dissimilar metals form a part of the assembly.

(3) If the assembly is an integral unit in the structure not subject to breakdown or disassembly in service.

(4) If waterproofing or insulating fabric or compounds subject to deterioration in the acid bath are not a part of the assembly.

(5) If the final organic protective coating forms a continuous unbroken film.

3. Electro-Plating

a. Non-corrosion resisting steel parts shall be cadmium plated unless they fall in one of the following classifications:

(1) Cable and parts fabricated from wire.

(2) Parts welded to unplated structure.

(3) Welded structure and hollow parts which cannot be cleaned to insure removal of the plating solution.

(4) Parts of mechanisms enclosed for lubrication.

(5) Areas acting as bearing, journals, or working surfaces.

b. Corrosion resistant steel castings or forgings which are not fully machined or polished shall be cadmium plated.

c. Brass, bronze, copper and lead parts in contact with dissimilar metals shall be cadium plated except where the contacting area is a working surface.

4. Chemical Treatment of Magnesium Alloys

Where the use of magnesium alloy is approved, parts made of this material shall receive Dow Treatment #7 in accordance with Navy Specification M-407.

5. Metal Spraying

Where specified, metal spraying shall be applied to carefully and freshly sandblasted surfaces in accordance with the latest applicable process specifications.

6. Chromic Acid

Where anodized material is cut or scratched through the film, the raw surface shall be treated with chromic acid. This treatment shall not be required for the edges of drilled or punched holes.

C. FINISH ON CONTACTING SURFACES

1. Similar Metals (For purposes of this specification, all aluminum alloy, with the exception of 52S and 24S where used in locations subject to contact with salt spray, shall be considered as similar). Organic finishes shall be applied to contacting surfaces of similar metals with the following schedules. Finish coats applied to a contacting surface may be counted as part of the required schedule.

NOTE: Zinc chromate primer tinted with one ounce of dry lamp black (Fed. Spec. TT-L-71) per gallon of package primer can be used wherever "Tinted Primer" or "Aluminized Primer" is specified but is not obtainable.

Fuller's P-27 black tinting paste may be substituted for the dry lamp black in the proportions of one pound of paste per five gallons of package primer. This primer shall be known as greem primer.

a. Skin or Plating Laps (seams)
2 coats of primer on each surface. The second coat may be aluminized.

b. Skin of Plating and Supporting Structure
2 coats of primer on each surface. The second coat may be aluminized.

c. Watertight Joints
(1) 2 coats of primer on each surface. The second coat may be aluminized.

(2) Fabric and marine glue shall be used in this type joint as a water seal.

(3) Zinc chromate past compound may be used in place of fabric and marine glue provided methods of application agreeable to the Inspector of Naval Aircraft are developed.

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d. Fuel Tight Seams

(1) 1 coat of primer on each surface.

(2) Neoprene sheet shall be used as a fuel seal in this type joint.

e. Oil Tight Seams

(1) No organic coating shall be required.

(2) Neoprene sheet shall be used as an oil seal in this type joint.

f. Joints Within Sub-assemblies - Meeting the Tabulated Requirements of Paragraph B.2.b. but which are Anodized in Detail.

1 coat of primer on each surface.

g. Bolts

Bolts in general shall be primed either before or during assembly. Body bound bolts or bolts having movement require no finish.

h. Spotwelded Joints and Joints in Sub-assemblies Anodized as a Unit

No finish on joining surfaces.

i. Rivets

(1) In the tank section, insert in bakelite varnish.

(2) Apply primer to machine countersunk surfaces before inserting rivet.

(3) Other than the above, no organic finish is required.

j. Press Fits

No organic finish is required on press fits.

k. Joints Not Included in the Above Classifications

2 coats of primer on each surface. The second coat may be aluminized.

2. Dissimilar Metals

a. Press Fits

No finish is required on the contacting surfaces.

b. Working Surfaces

The finish to be applied on sliding ways, adjustable screw threads, bearings, or other working surfaces shall consist only of the specified lubricant.

c. Tight Joints Within the Airplane. (Where the joint would be mechanically tight, as between two flat surfaces not subject to deflection during the joining operation.)

3 coats of primer on each surface.
Coats following the first may be aluminized.

d. Tight Joints Outside the Hull or Wing

Where tight joints occur outside of the hull they shall receive treatment similar to joints inside the hull with the addition of an insulating gasket of neoprene and a fillet of zinc chromate paste at the boundary of the joint.

e. Open Joints Within the Hull or Wing

Where the joint would not be mechanically tight, due to lack of fit or deflection of a surface during the joining operation, apply 2 coats of primer to each surface and assemble with a coating of zinc chromate paste in the joint in such a manner that the paste is squeezed out at all boundaries. Remove the excess paste in such a manner as to form a boundary fillet. This fillet should remain intact during the final finish.

f. Open Joints Outside the Hull or Wing

Where open joints occur outside of the hull they shall receive treatment similar to joints inside the hull with the addition of an insulating gasket of neoprene.

g. Bolts, Screws and Nuts

(1) Organic finish on bolts shall conform to Paragraph C.1.g.

(2) No organic finish shall be required on screws and nuts, before installation.

(3) The heads of steel bolts and screws and steel nuts bearing on aluminum alloy parts shall be insulated from these parts by alclad washers. Steel screws used in contact with aluminum alloy shall be set in zinc chromate primer or paste and touched up with primer immediately after installation.

h. Anchor Nuts (Steel) and Stanley Fasteners

(1) Apply 1 brush coat of zinc chromate primer to the contacting surface of the nut or fastener.

(2) Apply 2 coats of primer to the supporting surface.

(3) Assemble with zinc chromate paste in the joint such that excess material is squeezed out at all boundaries.

(4) Remove excess material in such a manner that a fillet shall be formed.

i. Dzus Fastener Springs

(1) No organic finish shall be required on the spring.

(2) When installed on an aluminum alloy structure, an alclad washer shall be placed between the spring and the structure and between the spring and the rivet head.

j. Electrical or Bonding Contacts

All organic finish and anodic film shall be removed from surfaces required to be in intimate electrical contact.

D. MISCELLANEOUS MATERIALS. The following general finish schedules shall apply except where a definite scheme is listed for a part under the airplane breakdown.

1. Magnesium

Alloy 4 (Dowmetal H)(AM-265) castings

Apply Dow Treatment No. 7
Immerse in hot tung oil (150° C. ± 2° C.) until gas evolution ceases.
Apply 2 prime.
Apply 2 pigmented coats to match adjacent surfaces.

2. Steel - Non-corrosion Resisting

a. Cable

(1) Do not plate.
(2) Immerse in paralketone prior to installation.
(3) Wipe with paralketone after installation

b. Chain

(1) Do not plate.
(2) Treat with paralketone prior to installation.

c. Springs, 1/4" or Less in Diameter or Thickness of Section

(1) Do not sandblast.
(2) Cadmium plate.
(3) Bake for 3 hours at 400° F.
(4) Apply 2 prime.

d. Springs Over 1/4" in Diameter or Thickness of Section

(1) Cadmium plate.
(2) Apply 2 prime.

e. Gear, Shafts, and Mechanism Parts Inclosed in Boxes

No finish.

f. Parts From Bar, Rod, Sheet and Castings

(1) Cadmium plate.
(2) Apply 1 prime.
(3) Apply 2 pigmented coats to match adjacent surface.

g. Sealed Structural Tubing

(1) Sandblast.
(2) Apply 1 prime.
(3) Apply 2 pigmented coats to match adjacent structure.
(4) Flush interior with paralketone, drain and seal.
(5) Also see engine mount, float brace strut, landing gear, propeller hoist, engine hoist.

h. Open Structural Tubing

(1) Sandblast exterior.
(2) Apply 2 prime to interior. Second coat may be aluminized.
(3) Apply 1 prime and 2 pigmented coats to match adjacent surfaces to exterior.

3. Steel - Corrosion Resisting

a. Welded Assemblies (exhaust stacks)

(1) Sandblast.
(2) Passivate.

b. Cable

(1) Immerse in paralketone prior to installation.
(2) Wipe with paralketone after installation.

c. Castings and Forgings not Fully Machined

(1) Cadmium plate
(2) Apply finish as necessary to match adjacent surface.

d. Fully Machined Parts

(1) Polish exposed surfaces.

(2) Passivate (This last operation may be omitted from parts where there is danger of entrapping the passivating acid. Swaged terminals are an example.

4. Copper and Copper Alloys

a. Bus bars

Cadmium plate.

b. Electrical Terminals

Purchase tinned

c. Bonding braid

Purchase tinned

d. Bronze bushings

Cadmium plate

e. Oilite bearings

No finish

f. Pipe fittings

Cadmium plate

g. Brass tank screens

Cadmium plate

h. Chain

Cadmium plate

5. Plastics

No finish shall be applied

6. Rubber and Neoprene

No finish shall be applied

7. Wood

Top surfaces of wood tables or interior parts.
A filler shall be applied across the grain. Excess filler shall be rubbed off.

1 coat of primer surface shall be applied by spraying. The surfaces shall be sanded between coats.

Apply 2 finishing coats of Shellac and 2 coats of wax.

8. Monel Metal

Rivets in preheater - no finish.

9. K - Monel

Chain for control system - lubricate.

10. Government Furnished Material

No finish shall be applied.

11. Fabric

a. The minimum finish for all fabric covering (wings and control surfaces) shall be 6 coats of clear nitrate dope and 1 coat of the specified camouflage finish.

b. The center section trailing edge shall be finished with 6 coats of clear nitrate dope, 2 coats of aluminized nitrate, and one coat of the specified camouflage finish.

c. The first 3 coats shall be brushed on and the remaining coats shall be sprayed.

d. Navy specification SR-70A shall be followed except that tautness rather than weight shall be the criterion for acceptance.

e. Carpeting used on the bow gunner's back rest shall receive 1 coat of lacquer on the reverse side to secure the pile from pulling out.

f. Ends of webbing straps shall be dipped in clear dope to prevent raveling unless a metal tip or other mechanical device is used.

## E. SPECIAL FINISHES AND CORROSION PREVENTIVE MEASURES

1. Acid Proofing

Surfaces within 12" of storage batteries and parts farther removed which are subject to acid spillage or spray shall be given 2 coats of lacquer over their normal finish.

2. Potassium Dichromate

Crystals of potassium dichromate shall be supplied in aluminum mesh containers and installed in the sump and low points of all fuel tanks and in the low point of each individual compartment of floats and hulls. Provision for the inspection and replacement of this material shall be made.

3. Beeswax and Grease and/or Paralketone

Paralketone and/or a mixture of beeswax and grease shall be applied at the following points:

a. Paralketone

(1) Wing splice bolts - external
(2) Low rudder hinge fitting
(3) Bow mooring pendant fitting on keel
(4) Tow ring aft on keel
(5) Flare opening door fittings
(6) Main and nose landing gear fittings and struts
(7) Main and nose landing gear attaching fittings on hull
(8) Antenna hooks
(9) Elevator horn bolts (attaching and connecting)
(10) Inboard ends of elevator torque tubes (bolts and joints)
(11) Float strut fittings on floats
(12) Float strut fittings in wing
(13) Float strut fittings in struts
(14) Float tow rings
(15) Main and nose wheel wells (exterior surface)

b. Beeswax and Grease

(1) Wing strut ends and fittings on hull and center section
(2) Beaching gear fittings on hull chine
(3) Hull tail cone joint
(4) Inboard rib of elevator tip
(5) Elevator middle hinge box
(6) Rear spar of stabilizer at island cut out
(7) Inboard side of inboard rib of island at cut out

4. Zinc Chromate Paste

All openings and fissures in the hull structure below the water line and in inaccessible locations, particularly where the protective finish may be damaged, which would tend to catch and retain moisture, shall be filled with zinc chromate paste. If possible, the material shall be applied during assembly to insure intimate contact. This material is stocked as Grade 3 for fillets and Slushing compound for faying surfaces. Grades 1 or 2 may be used for water-tight joints in the hull and floats.

## F. COLOR SCHEME

1. The exterior color scheme shall be as follows:

a. Surfaces visible from the upper sphere shall be covered with du-Pont Camouflage Enamel #71-031 and surfaces visible from the lower sphere shall be covered with du-Pont Camouflage Enamel #71-030. Refer to C.A.C. Dwg. 28Z5502 for demarcation lines.

2. Exceptions to the exterior color scheme are as follows:

| | |
|---|---|
| Retractable landing gear assembly | Black |
| Nose-Wheel assembly | Black |
| Landing light compartment | Dull Black |

3. Propeller tips and faces shall not be painted.

4. Insignia and marking shall conform with Drawing 28Z5502.

5. The interior color scheme shall be as follows:

| | |
|---|---|
| Instrument Panels | Dull Black |
| Bomber's and Pilot's Compartment | Tinted Primer |
| Hull interior aft of pilots' compartment | Aluminized Primer |
| Interior of wing, tail surfaces, auxiliary floats and nacelles | Aluminized Primer |

## G. TYPES OF MATERIAL

The following list establishes the exact type and grade of material which shall be understood when a general term is used in the body of this specification:

| | | |
|---|---|---|
| 1. | Primer | NAF P-27b-2<br>Standard formula must be used in fuel tanks |
| 2. | Lacquer | NAF L-12b |
| 3. | Nitrate dope, clear | NAF D-15d |
| 4. | Bakelite varnish | NAF V-10e |
| 5. | Linseed Oil | Commercial |
| 6. | Aluminum Paste | NAF-RM-137-1 Type II |
| 7. | Zinc Chromate Paste | Fuller's |
| 8. | Zinc Chromate Slushing Compound | Fuller's |
| 9. | Paralketone | NAF-RM-61c-1 |

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| | | |
|---|---|---|
| 10. | Marine Glue | Ferdico Liquid Aviation Marine Glue |
| 11. | Thinner, nitrate and lacquer | NAF T-25e-1 |
| 12. | Foil, aluminum | Navy 47-A-5b |
| 13. | Tung oil | Navy 52-0-16 |
| 14. | Enamel, black | NAF E-6e-1 |
| 15. | Anti-seize for threads | Navy M-319a |
| 16. | Glyptal, Red 1201 | General Electric |
| 17. | Non-specular Camouflage Lacquer | BuAero M-485 |
| 18. | Camouflage Enamel | du-Pont #71-030 & 71-031. |
| 19. | Nitrate Dope, pigmented, camouflage | A.C. 14106 |

## H. WINGS

### 1. Center Wing Panel

#### a. Aluminum Alloy Parts

(1) Bulkheads, spars and sub-assemblies
Anodize and prime in detail
Apply 1 aluminized prime after subassembly to areas outside of fuel space.

(2) Stringers and details
Anodize and prime in detail
Apply 1 aluminized prime in detail to areas outside of fuel space.

(3) Skin plating
Anodize and prime both sides in detail
Apply 1 aluminized prime in detail to inside surface areas outside of fuel space
Apply 1 aluminized prime to outside contacting surfaces.

#### b. Aluminum Alloy Parts (Alclad)

(1) Bulkheads, spars and sub-assemblies
Anodize and prime in detail.

(2) Stringers and details
Anodize and prime in detail.

(3) Skin plating
Anodize and prime both sides in detail
Apply 1 aluminized prime to outside contacting surfaces.

#### c. Non-aluminum Alloy Parts

See "Miscellaneous Materials"

d. Final Interior Finish

Touch up rivet heads and scratches with primer. Apply 1 aluminized prime to all areas outside of fuel space.

e. Final Exterior Finish

Apply 1 coat of glyptal to the tank sump exteriors.
Clean and touch up with primer all over.
Apply 2 camouflage lacquer. See "Color Scheme".
Apply insignia and markings.

2. Outer Wing Panels

a. Aluminum Alloy Parts

(1) Bulkheads, spars, and subassemblies
Anodize and prime in detail.
Apply 2 aluminized prime after subassembly.

(2) Stringer and details
Anodize, prime and 2 aluminized prime in detail.

(3) Skin plating
Anodize and prime both sides in detail.
Apply 2 aluminized prime to inside surface.
Apply 1 aluminized prime to outside contacting surfaces.

b. Aluminum Alloy Parts (Alclad)

(1) Bulkheads, spars and subassemblies
Anodize and prime in detail.
Apply 1 aluminized prime after subassembly.

(2) Stringers and details
Anodize, prime and 1 aluminized prime in detail.

(3) Skin plating
Anodize and prime both sides in detail.
Apply 1 aluminized prime to inside surface.
Apply 1 aluminized prime to outside contacting surfaces.

c. Non-aluminum Alloy Parts

See "Miscellaneous Materials"

d. Final Interior Finish

Touch up rivet heads and scratches with aluminized primer as assembly progresses.

e. Final Exterior Finish

Clean and touch up with primer.
Apply 2 camouflage lacquer. See "Color Scheme".
Apply insignia and markings.

3. Leading Edge Sections

a. Aluminum Alloy Parts

(1) Bulkheads, formers and sub-assemblies.
Anodize and prime in detail.
Apply 1 aluminized prime after sub-assembly.

(2) Stringers and details
Anodize, prime and aluminized prime in detail.

(3) Skin plating
Anodize and prime both sides in detail.
Apply 1 aluminized prime to inside surface.
Apply 1 aluminized prime to outside contacting surfaces.

b. Aluminum Alloy Parts (Alclad)

(1) Bulkheads, formers and subassemblies.
Anodize and prime in detail.

(2) Stringers and details
Anodize and prime in detail.

(3) Skin plating
Anodize and prime both sides in detail.
Apply 1 aluminized prime to outside contacting surfaces.

c. Non-aluminum Alloy Parts

See "Miscellaneous Materials"

d. Final Interior Finish

Touch up rivet heads and scratches with primer.
Apply 1 aluminized primer.

e. Final Exterior Finish

Clean and touch up with primer.
Apply 2 camouflage lacquer. See "Color Scheme".
Apply insignia and markings.

4. Center Panel Trailing Edge

a. Aluminum Alloy and Alclad Parts

(1) Ribs and sub-assemblies
Anodize and prime in detail.
Apply 1 aluminized prime after subassembly.

(2) Trailing Edge Member
Anodize and prime in detail
Apply 2 aluminized prime inside and out after subassembly.

(3) Details
Anodize, prime and 1 aluminized prime.

b. Non-aluminum Alloy Parts

See "Miscellaneous Materials"

c. Final Structural Finish

Touch up rivet heads and scratches with primer.
Apply 1 aluminized primer.

d. Fabric Cover

Apply 6 clear nitrate dope.
Apply 2 coats of aluminized nitrate dope.
Apply 1 camouflage lacquer. See "Color Scheme."

5. Outer Panel Trailing Edge

a. Aluminum Alloy and Alclad Parts

(1) Ribs and sub-assemblies
Anodize and prime in detail.
Apply 1 aluminized prime after subassembly.

(2) Trailing Edge Member
Anodize and prime in detail.
Apply 2 aluminized prime inside and out after sub-assembly.

(3) Details
Anodize, prime and 1 aluminized prime

b. Non-aluminum Alloy Parts

See "Miscellaneous Materials"

c. Final Structural Finish

Touch up rivet heads and scratches with primer.
Apply 1 aluminized prime.

d. Fabric Cover

Apply 6 clear nitrate dope.
Apply 1 camouflage lacquer. See "Color Scheme."

6. Ailerons

a. Aluminum Alloy Parts

(1) Spars, ribs and sub-assemblies
Anodize and prime in detail.
Apply 1 aluminized prime after subassembly.
Apply 1 additional aluminized prime to areas not accessible for painting after final assembly.

(2) Trailing Edge Member
Anodize and prime in detail.
Apply two aluminized prime inside and out after sub-assembly.

(3) Details
Anodize, prime and 1 aluminized prime.

b. Aluminum Alloy Parts (Alclad)

(1) Spars, ribs and sub-assemblies
Anodize and prime in detail.

(2) Details
Anodize and prime
Apply 1 additional aluminized prime to areas not accessible for painting after final assembly.

c. Non-aluminum Alloy Parts

See "Miscellaneous Materials"

d. Final Structural Finish

Touch up rivet heads and scratches with primer.
Apply 1 aluminized prime.

e. Fabric Cover

Apply 6 clear nitrate dope.
Apply 1 camouflage lacquer. See "Color Scheme."

7. Wing Struts

a. Tube (Detail)

Anodize and prime.
Apply 1 aluminized prime to interior.

b. Reinforcement (detail)

Anodize, prime and 1 aluminized prime.

c. Fittings (detail)

Anodize, prime and 1 aluminized lacquer

d. Strut (assembled)

Apply 1 flowcoat of aluminized prime to interior.
Apply 2 camouflage lacquer to exterior. See "Color Scheme."
Dip each end to depth of 18 inches in beeswax and grease mixture.

I. TAIL SURFACES

1. Fin and Stabilizer (less fabric-covered tip)

a. Aluminum Alloy Parts

(1) Ribs, spars, and sub-assemblies
Anodize and prime in detail.
Apply 2 aluminized prime after subassembly to all surfaces not accessible for painting after final assembly.

(2) Stringers and details
Anodize, prime and 2 aluminized prime in detail.

(3) Skin plating
Anodize and prime both sides in detail
Apply 2 aluminized prime to inside surface

Apply 1 aluminized prime to outside contacting surfaces.

b. Aluminum Alloy Parts (Alclad)

(1) Ribs, spars and sub-assemblies
Anodize and prime in detail
Apply 1 aluminized prime after sub-assembly to all surfaces not accessible for painting after final assembly.

(2) Stringers and details
Anodize, prime and 1 aluminized prime in detail.

(3) Skin plating
Anodize and prime both sides in detail.
Apply 1 aluminized prime to inside surface.
Apply 1 aluminized prime to outside contacting surfaces.

c. Non-aluminum Alloy Parts

See "Miscellaneous Materials"

d. Final Interior Finish

Touch up rivet heads and scratches with primer as assembly progresses.

e. Final Exterior Finish

Clean and touch up with primer.
Apply 2 camouflage lacquer. See "Color Scheme."

2. Elevators and Stabilizer Tip

a. Aluminum Alloy Parts

(1) Ribs, spars and sub-assemblies
Anodize and prime in detail.
Apply 1 aluminized prime after assembly.

(2) Details
Anodize, prime and 1 aluminized prime in detail.

(3) Closed sections
Apply 1 additional aluminized prime to areas not accessible for painting after final assembly.

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b. Aluminum Alloy Parts (Alclad)

(1) Ribs, spars and sub-assemblies
Anodize and prime in detail

(2) Details
Anodize and prime in detail

(3) Closed sections
Apply 1 additional aluminized prime to areas not accessible for painting after final assembly.

c. Non-aluminum Alloy Parts

See "Miscellaneous Materials"

d. Final Structural Finish

Touch up rivet heads and scratches with primer
Apply 1 aluminized prime

e. Fabric Cover

Apply 6 clear nitrate dope
Apply 1 camouflage lacquer. See "Color Scheme."

3. Rudder

a. Aluminum Alloy Parts

(1) Ribs, spars and sub-assemblies
Anodize and prime in detail
Apply 1 aluminized prime after subassembly

(2) Details
Anodize, prime and 1 aluminized prime in detail

(3) Closed sections
Apply 1 additional aluminized prime to areas not accessible for painting after final assembly.

b. Aluminum Alloy Parts (Alclad)

(1) Ribs, spars and sub-assemblies
Anodize and prime in detail

(2) Details
Anodize and prime in detail

(3) Closed sections
Apply 1 additional aluminized prime to areas not accessible for painting after final assembly.

c. Non-aluminum Alloy Parts

See "Miscellaneous Materials"

d. Final Structural Finish

Touch up rivet heads and scratches with primer.
Apply 3 aluminized primer.
Insulate the structure from the fabric with foil.
Apply 1 aluminized primer to foil.

e. Fabric Cover

Apply 6 clear nitrate dope
Apply 1 camouflage lacquer. See "Color Scheme."

J. HULL See paragrpah J.l.f. on main wheel and nose wheel wells.

1. General

a. Aluminum Alloy Parts

(1) Bulkheads, frames and sub-assemblies.
Anodize and prime in detail.
Apply 1 aluminized prime after sub-assembly.

(2) Details
Anodize, prime and 1 aluminum prime in detail.

(3) Skin plating
Anodize and prime both sides in detail
Apply 1 aluminized prime to inside surface
Apply 1 aluminized prime to outside contacting surfaces.

b. Aluminum Alloy Parts (Alclad)

(1) Bulkheads, frames and sub-assemblies.
Anodize and prime in detail.

(2) Details
Anodize and prime in detail.

(3) Skin plating
Anodize and prime both sides in detail
Apply 1 aluminized prime to outside contacting surfaces.

c. Non-aluminum Alloy Parts

See "Miscellaneous Materials."

d. Final Interior Finish

(1) Apply 1 tinted prime from bulkhead #2 forward.

(2) Apply 1 aluminized prime from bulkhead #2 aft.

(3) All metal parts within the pilot's enclosure from approximately the lower edge of the pilot's switch panel around both sides to the lower edge of the pilot's instrument panel, shall be finished with dull black lacquer (same as PBY-5).

(4) Apply markings.

NOTE: In sections like the lower fin, the final interior finish may be applied before riveting the skin in place, provided the rivet heads are touched up after plating. It will not be necessary to paint surfaces of stringers, beltframes, etc., unexposed to the cockpit.

e. Final Exterior Finish

Touch up or replace exterior prime coat.
Apply 2 camouflage lacquer. See "Color Scheme"

f. **Main Wheel and Nose Wheel Wells**

Interior (Surface within Hull) Same as Interior of "Hull".
Exterior (Exposed Surface) Same as exterior of "Hull."
Apply one coat of paralketone.

2. Wing Tip Float Installation

a. Wing Tip Floats

(1) Aluminum Alloy Parts

(a) Details
Anodize, prime and 1 aluminized prime in detail

(b) Skin plating
Anodize and prime both sides in detail
Apply 1 aluminized prime to inside surface
Apply 1 aluminized prime to outside contacting surface

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(2) Non-aluminum Alloy Parts

See "Miscellaneous Materials"

(3) Final Interior Finish

(a) Touch up rivet heads and scratches with aluminized primer

(b) Apply 1 aluminized prime. This finish may be applied before all plating is installed, provided all rivet heads receive a minimum of two organic coats.

(4) Final Exterior Finish

(a) Clean and touch up with primer

(b) Apply 2 camouflage lacquer. See "Color Scheme."

b. Float Brace Panel

(1) Aluminum Alloy Parts

(a) Sub-assemblies
Anodize and prime in detail.
Apply 2 aluminized prime after sub-assembly.

(b) Details
Anodize, prime and 2 aluminized prime in detail.

(c) Skin Plating
Anodize and prime both sides in detail.
Apply 2 aluminized prime to inside surface.

(2) Non-aluminum Alloy Parts

See "Miscellaneous Materials"

(3) Final Interior Finish

Touch up rivet heads and scratches with primer as assembly progresses.

(4) Final Exterior Finish (Float Brace Panel)

Clean and touch up with primer
Apply 2 camouflage lacquer, See "Color Scheme"

c. Float Struts

(1) Interior Finish

Flush with paralketone, drain and seal.

(2) Exterior Finish

(a) Sand blast.
(b) Metal spray with aluminum.
(c) Apply 1 prime.
(d) Apply 2 camouflage lacquer. See "Color Scheme."

## K. ENGINE NACELLES

### 1. Engine Mounts

a. Interior Finish

Flush with paralketone, drain and seal.

b. Exterior Finish

(1) Sand blast.
(2) Metal spray with aluminum.
(3) Apply 1 prime and 1 aluminized lacquer.

### 2. Oil Tanks

a. Aluminum Alloy Parts

(1) Anodize in detail

(2) Prime in detail areas not part of oil tank interior or surfaces of oil-tight joints.

b. Non-aluminum Alloy Parts

See "Miscellaneous Materials"

c. Final Interior Finish

No interior finish required

d. Final Exterior Finish

(1) Apply 2 camouflage lacquer to top (exposed) surface. See "Color Scheme."

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e. Aluminum Alloy Parts (Brackets, Pedals, Levers)

Anodize, prime and 2 pigmented prime to match interior color scheme.

f. Non-aluminum Alloy Parts

See "Miscellaneous Materials".

3. Electrical Equipment

a. Conduit fittings

(1) Do not anodize.
(2) Apply 1 prime and 1 pigmented coat to match adjacent surface.

b. Junction boxes

(1) Do not anodize.
(2) Apply 1 prime inside.
(3) Apply 1 prime and 1 pigmented coat.to match adjacent surface.

c. Conduit (solid)

(1) Do not anodize.
(2) Apply no interior finish
(3) Apply 1 prime and 1 pigmented coat to match adjacent surface.

d. Conduit (flexible)

No finish shall be applied.

e. Electrical contacts

(1) Remove all anodic film and organic finish, if present, from areas where intimate electrical contact is desired.

(2) After contact is made, the joint shall be sealed with three coats of organic finish to match adjacent surfaces

(3) Electrical joints in exterior locations, such as control surface hinge bonds, shall receive a coating of anti-corrosive grease in addition to the above.

4. Furnishings

a. Miscellaneous Aluminum Alloy Parts

(1) Anodize
(2) Apply 1 prime and 2 pigmented prime to match adjacent surfaces.

NOTE: Sub-assemblies meeting the requirements of paragraph B.1.b., need not be anodized and primed in detail.

b. Non-aluminum Alloy Parts

See "Miscellaneous Materials"

c. Fire Extinguisher and De-Icer Lines

(1) Anodize.
(2) Apply no finish to interiors.
(3) Apply 1 prime and 1 pigmented prime to match adjacent surface.
(4) Apply markings according to"Piping Identification Chart", Part IV.

## M. RETRACTABLE LANDING GEAR

### 1. Main Gear and Nose Gear

a. Aluminum Alloy Parts (Wheels, etc.)

(1) Anodize and prime in detail.
(2) Apply 1 prime and 1 black lacquer after assembly.

b. Corrosion Resistant Steel

(1) Prime in detail.
(2) Apply 1 prime and 1 black lacquer after assembly.

c. Steel Castings

(1) Sandblast.
(2) Cadmium plate and prime in detail.
(3) Apply 1 prime and 1 black lacquer after assembly.

d. Sealed Steel Structural Parts

(1) Sandblast.
(2) Cadmium plate and 1 prime in detail.
(3) Apply 1 prime and 1 black lacquer.
(4) Treat the interior with paralketone and seal.

### 2. Main Landing Gear Finish

Apply 1 coat of camouflage to match adjacent hull surfaces.